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ENDING OF THE FEDERAL INCANDESCENT LAMP SUIT.

Elsewhere will be found a full abstract of the decree entered last week at Toledo, which closes the proceedings commenced last March at Cleveland when the federal government filed suit against incandescent lamp companies for alleged violation of the Sherman anti-trust law. As will be seen, the decree orders the dissolution of the National Electric Lamp Company, of which the entire stock is now held by the General Electric Company, and of its twenty subsidiary companies, the business of which must hereafter be conducted in the name of the General Electric Company; the defendants are enjoined from making agreements with manufacturers of lamp-making machinery and glassware which will prohibit the latter from making similar agreements with others; all parties to the suit are enjoined from entering into any combination or agreement fixing resale prices of lamps or imposing conditions having any bearing on such resale or discriminating in any manner against purchasers who do not buy ordinary carbon-filament lamps from the manufacturers also of other lamps covered or claimed to be covered by patents, such as graphitized and metallic-filament lamps; the practice is enjoined of imposing differentials in price between lamps which do not differ in quality and efficiency, and of allowing discounts based on aggregate purchases from different manufacturers or on aggregate purchases of different types of lamps, or making favorable prices having the purpose to drive rival manufacturers out of business. A prohibition which may have an important bearing on future litigation relating to trade combinations is an injunction restraining the General Electric Company from exercising an option to purchase the capital stock of a nominally independent lamp company, or from exercising any influence or control over that company by virtue of said option.

So far as relates to central stations and other consumers of incandescent lamps, the decision in the case appears to be quite sharply limited in effect to creating an open market for the ordinary carbon-filament lamp, in which trade competition alone will regulate prices. As that type of lamp, however, is now less used than the modern high-efficiency lamp and is rapidly becoming obsolete, the consumer will not be greatly benefited by its release from artificial price conditions. Although the jobber and dealer are frequently mentioned in the decree, it is not clear that they will greatly benefit. The open market for the old carbon-filament lamp will undoubtedly reduce the margin of profit which existed when its selling price was practically fixed by the lamp combination; and the licensors of the high-efficiency patented lamps, being also the largest sellers of such lamps to consumers, will be able virtually to fix within a narrow margin the price at which such lamps can be sold at a

living profit by licensees and dealers. In fact, the decree is more liberal in regard to the patent aspect of the case than some courts which have considered the relation of the patent monopoly to the public with respect to the right of the inventor to an absolutely unrestricted monopoly. It is expressly stated that the owner of a lawful patent may grant to another a license under such a patent upon terms and conditions fixed by the licensor, the single limitation of the decree being that the licensor shall not fix a resale price.

The decree is thus confined solely to the matter of combinations in restraint of trade, except in so far as it prohibits the fixing of a resale price of a patented article, and does not touch on the larger question brought forward in the Cleveland petition relating to the influence of patents on the commercial monopolization of an industry or a branch thereof. The decree, with perhaps the exception of the resale prohibition, is merely a restatement in concrete form of the general policy of the government, as recently developed, in the enforcement of the Sherman anti-trust law, and the Cleveland case was treated rather from this standpoint than with respect to the special industrial conditions involved. Perhaps it was wisest thus to narrow the cause upon which judgment was to be passed, owing to the extremely complicated nature of that part ignored, which would have involved an interpretation of the patent monopoly more far-reaching in effect than the simpler interpretation of the Sherman law in the light of recently established and strong precedents. In view, however, of the enormous commercial influence of patents in the electrical field at the present time, it is nevertheless to be regretted that the patent aspect of the case was not thoroughly gone into; for the Cleveland petition made allegations on the subject which are not set at rest by the decree, and introduced specifically a question relating to the status of foreign patents which some time will require an answer. It would have been far better for the electrical industry if the government had seen its way clear to dispose of the entire case as set forth in the Cleveland petition, instead of neglecting allegations which, made by the federal government and now on record, will eventually reappear in litigation. Of course, it is not within the province of a court to revise our present unsatisfactory patent system, which is a task for the legislative branch of the government. But such action would doubtless be much advanced by rulings in conspicuous cases that would reveal to the nation, and thereby to Congress, the great need of a drastic overhauling of a code now absolutely out of harmony with present-day industrial and commercial conditions.

AUGUST ELECTRICAL EXPORTS.

The great dullness of summer trade this year is reflected in the statistics of electrical exports for August, and beyond that remark they call for hardly any other comment. The exports of heavy electrical machinery were valued at $666,544 as compared with $708,160 in August, 1910, while the exports of electrical instruments were $725,145 as compared with $852,958. The total was $1,391,689 as against $1,561,118. It is obvious that electrical consumption and development wait upon the general tendencies of world trade, and are not likely to gain and grow where people feel poor or are preoccupied with fighting. The conditions of financial unrest and uncertainty appear to have general prevalence, but intrinsically the fact remains the same, namely, that the world at large is still very inadequately supplied with electrical apparatus.

HARMONIC ANALYSIS OF ALTERNATING-CURRENT WAVES.

It is remarkable how increasingly important becomes Fourier's wonderful theorem of harmonic analysis in the progress of applied science. This theorem finds its use in many different branches of engineering. In alternating-current theory it is becoming more generally employed every year. In fact, it is now so frequently employed that students often misapprehend it and suppose that irregular wave-forms embody harmonics; whereas the Fourier theorem states only that they behave as though they embodied harmonics. The distinction from a practical standpoint may be trivial, but from a logical standpoint is profound. The effects of alternating current of complicated wave-form can most easily be understood by analyzing them into their Fourier components; that is, into an association of a fundamental and a series of harmonic currents. In practice, all alternating-current waves are non-sinusoidal. Even so-called sinusoidal waves are actually only approximations to the true geometrical form, and, if a sufficiently high degree of accuracy is called for, they too must be subjected to Fourier analysis. Fortunately, however, for most practical engineering purposes, this refinement can be neglected, and in most instances only the fundamental frequency needs to be considered.

When, for any purpose of investigation, the effects of the harmonics in alternating-current waves must be taken into account, the first step is to find what the harmonics are. This may be done by experimental analysis in the laboratory, but it is ordinarily accomplished by securing an oscillographic record of the alternating wave of current or emf, to rectangular co-ordinates, and subjecting the recorded curve to Fourier analysis. Fourier analysis is a large subject, with an extended literature, and there is at least one book written exclusively on "The Production and Analysis of Alternating-Current Waves" (by Prof. Dr. Ernst Orlich, in German). In electrical engineering practice, however, two methods of Fourier analysis are in general use. One is the Runge method, and the other the Fischer-Hinnen method. Both are so called "schedule" methods. That is, they both employ a certain schedule, prepared in advance, according to the number of harmonics to be included, and the ordinates of the wave are measured at an assigned number of points, the said measured ordinates being then written on the schedule, which prescribes an arithmetical treatment of them leading to the evaluation of the required harmonics amplitudes. The Fischer-Hinnen schedule can be made the swifter of the two in any ordinary case as far as the eleventh harmonic inclusive, since it calls only for the successive additions of sets of ordinates, whereas the Runge schedule calls for successive

additions of sets of ordinates, with multiplication by proper sine-coefficients. Each method is inherently inaccurate, to the extent that it assumes that no other harmonics exist save those included in the schedule. But the errors involved in the Fischer-Hinnen method are apt to be greater than those involved in the Runge method.

The article by Messrs. C. A. Pierce and William Anderson, published on page 1007 of this number, discusses the relative advantages of the two methods, and sums up in favor of the Runge method. It is obvious that it is useless to pursue any method of Fourier analysis beyond the degree of precision that the original wave outline will warrant. In many cases the oscillographic wave record is not sufficiently sharp and definite to enable the ordinates to be read with a precision greater than one part in thirty. Discrepancies due to imperfections in ordinate reading lead to exaggerated discrepancies in the evaluated amplitudes of the higher harmonics. In the rare cases where a fine and definite large-scale wave-record has been secured, and the highest practicable degree of precision is called for in the analysis, neither the Runge nor the Fischer-Hinnen method finds its best adaptation. Either the Slichter method with its specially ruled charts, as described in our columns on July 15, 1909, or the Michelson harmonic analysis, is then indicated.

PUBLIC HYDROELECTRIC ENTERPRISES IN FRANCE.

We are wont to think of our own country as somewhat pre-eminent in the matter of electric energy transmission, and so indeed from many standpoints it is, yet few of us realize how much of actual enterprise has been shown elsewhere. Switzerland is full of power-transmission lines and so is northern Italy, but the large number of hydroelectric installations that have been made in France is surprising to those who have not followed this development. The ordinary American traveler thinks of France as far from being a country of abundant water-powers. He does not fully realize the mountainous character of great portions of France nor the industry of its people in hunting out water-powers in locations and of capacities which here remain unutilized. A recent muster-roll of French public hydroelectric stations has been made by our Paris contemporary, *La Revue Electrique*, and it is altogether surprising, not only in extent, but in character. It is shown that in the four great river basins of France there were at last accounts no less than 857 public hydroelectric installations. Of these the Rhone Valley, of course, easily holds the first place in number and in importance, but the Garonne Valley is not far behind, and those of the Seine and Loire add considerably to the total.

From an economic standpoint the plants of the Seine Valley are particularly interesting, since these are in a relatively flat country where the average fall is small and where utilization of small powers has perhaps been pushed further than elsewhere. There are 149 public hydroelectric power plants established on the Seine and its tributaries, about two-thirds of them for strictly local use and the remainder furnishing energy to several localities. An examination of the roster of plants upon these particular watersheds reveals a very curious and interesting state of affairs. Its most extraordinary feature is the thoroughness with which powers of so trivial a size that they would hardly be seriously considered here have been harnessed and put to good use. The general topography of the country is strongly in evidence when one examines the available heads employed in these several plants. Only four of the entire number show a head of over 10 m and these are all small, considerably under 100 hp. The utilization of falls of between 1 m and 2 m is common, and the average head seems from a rough survey of the data to be not over 3 m. Most of the installations, too, are of small size, only two of the list rising to the dignity of 200 hydraulic hp and not a few running under 10 hp, yet they are all put to service and worked for what they are worth with characteristic French industry. As might be expected from the small amount of power, the transmissions are generally short, 12 miles being the longest, and the voltages employed are consequently low, in a very large number of instances not exceeding 250 volts. A single 15,000-volt installation marks the maximum pressure employed. Almost the whole of the plants recorded, therefore, belong to the type of small plants, chiefly for local lighting and industries employing motors, and serve communities of very small population. They are, however, a striking example of making the most of small opportunities. Wherever a little fall exists it is promptly utilized either for local affairs or for reinforcing a small existing central station. Apparently none is too low or too small to escape careful scrutiny with a view of utilization.

Considering the number of plants and their communal ownership, one instinctively wonders why the union of individual powers into a network is so rarely attempted, as has become the custom in this country. A study of the situation, however, tells the story. There are, for instance, in the Department of the Marne twenty-one such hydroelectric plants. Only one of the number reaches 100 hp and the rest range between 3 hp and 45 hp; twelve of the number, including the single 100-hp plant, are operating on heads of less than 2 m. The chance for combined action, considering the small size of the individual equipments, is obviously hardly worth considering, yet all the plants are serving a useful purpose for their several communities. A situation like this is certainly a lesson in economics which the inhabitants of rural districts in our own country may well take to heart. Fancy a little New England village of 200 or 300 inhabitants taking advantage of a 6-ft. fall yielding 20 hp or 25 hp for the establishment of a town plant; yet this is precisely the thing which many a small commune in rural France has done, to say nothing of similar plants established entirely for private use. There is nothing in these little powers to encourage the promoter, and no profits to accrue save those derived from operation with rigid economy, yet they serve a most useful purpose and may be made to pay a fair return on the cash actually spent. If the whole truth were known, it would probably be found that not a few of these little French plants are almost automatic in their arrangement and are administered with a rudimentary simplicity that we find it difficult to imagine; yet they accomplish their purpose and teach a lesson in resourcefulness and economy that should not pass unheeded.

Cleveland Incandescent Lamp Case.

On Oct. 12 Judge John M. Killits, of the United States Circuit Court, sitting at Toledo, Ohio, handed down a decree disposing of the federal suit entered in the United States Circuit Court at Cleveland on March 3 against thirty-five electrical and other manufacturing companies on the charge of engaging in "unlawful contracts, combinations and conspiracies to restrain the trade and commerce among and between the several states and territories of the United States in incandescent lamps and to monopolize the same." A full account of the charges then filed is given in the issue of the *Electrical World* for March 9.

An answer in the suit was filed June 5, which consisted of a denial in detail of the allegations made, and included a statement that since the filing of the suit the General Electric Company, which owned 75.2 per cent of the stock of the National Electric Lamp Company, had closed an option and purchased the remainder of the stock, which had been held by the National Electric Lamp Company under an agreement that the entire management and control of that company should be vested in and exercised by the party holding the minority interest.

The decision of Judge Killits is in the form of a decree, and represents an agreement arrived at between Attorney-General Wickersham and the defendant corporations. The decree dismisses the complaint against the Kentucky Electrical Company, and does not mention the complaints against the Libbey Glass Company, Phoenix Glass Company, York Electric Machine Company and Dyer Machine Company, which had been charged with making agreements with the defendant lamp companies to give to them better prices and terms on glass bulbs, lamp bases and lamp-making machinery than to their competitors, the additional charge being that these companies were controlled by the incandescent lamp corporations. It is understood that the government dropped its case against these manufacturers.

The preamble of the decree cites that the defendants, by leave of the court, withdraw their answers to the suit and state in open court, through their counsel, that it is not their desire or intention to violate the provisions of the act under which they are indicted; that it is their desire and intention to comply with the statutes of the United States referring to agreements, combinations or conspiracies in restraint of trade; that their previous action in the premises was in the belief that it was not in violation of the law, and that it is not their desire or intention to operate under or make or carry on such contracts or practices as are condemned by Congress, as now construed by the court. The court then proceeded to give the terms of the decree, the entry of which was not opposed by the defendants, with the preliminary statement that it finds that the defendants are and have been engaged in unlawful agreements and combinations in restraint of trade, and that the doing of the several acts and things set forth in the petition and to be enjoined are unlawful.

The decree states that the General Electric Company is now the owner of the entire capital stock of the National Electric Lamp Company, and at the time of the filing of the suit was the owner of the majority of such stock; that the National Electric Lamp Company is in turn the owner of the entire capital stock of the subsidiary companies mentioned in the suit; that such stock ownership has been concealed from the general public and the trade; and that, notwithstanding such stock ownership, the General Electric Company, the National Electric Lamp Company and the latter's subsidiary companies are pretending to be separate, distinct, independent and competing companies in the business of manufacturing, dealing in and selling incandescent electric lamps, whereas no such independence or competition exists or has existed; and that the General Electric Company has heretofore been largely engaged in carrying on an incandescent lamp business indirectly through said companies. It is therefore ordered that the National Electric Lamp Company and all of its subsidiary companies be each and all of them dissolved, and the General Electric Company is enjoined from hereafter conducting, excepting in its own name, the business heretofore or hereafter carried on by it in incandescent lamps of any and every description. It is further ordered that all factories, plants and all manufacturing and selling departments operated and owned by the General Electric Company for the manufacture and sale of incandescent lamps shall be made known to the general public and trade as the property and business of that company; provided that the General Electric Company is not prohibited using the trade names of incandescent lamps lawfully manufactured or sold by it, including the trade names now employed by the National Electric Lamp Company and its subsidiaries, if it acquires such trade names and the business of manufacturing lamps to which the same are applied, but such names shall be known as the property of the General Electric Company.

The decree names the following as the companies subsidiary to the National Electric Lamp Company: American Electric Lamp Company, Banner Electric Company, Brilliant Electric Company, Bryan-Marsh Company, Buckeye Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, General Incandescent Lamp Company, Economy Electric Company, Fostoria Incandescent Lamp Company, Independent Incandescent Lamp Company, Munder Electric Company, New York & Ohio Company, Shelby Electric Company, Standard Electrical Manufacturing Company, Sterling Electrical Manufacturing Company, Sunbeam Incandescent Lamp Company, Fostoria Bulb & Bottle Company, Providence Gas Burner Company and Warren Electric & Specialty Company.

The General Electric Company, together with the above-mentioned defendants and the Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company, Aetna Electric Company, Capital Electric Company, Franklin Electric Manufacturing Company, Liberty Electrical Manufacturing Company and Gilmore Electric Company, is enjoined from making or carrying out, directly or indirectly, any contracts with any manufacturer of lamp-making machinery or with any manufacturer of bulbs and tubing for incandescent lamps whereby such manufacturer is bound not to sell his goods to others than the said defendants or any of them or to sell to the said defendants or any of them at other and different prices and terms of payment than those to which they severally may sell to other purchasers.

All of the defendants above noted are enjoined from fixing by combination, or any other act between any two or more of them, or between any of them and others, the price at which any incandescent electric lamp of any pattern, character or type, whether made or sold under letters patent, license or otherwise, shall be sold either at wholesale or retail; provided that any of the defendants lawfully owning patents may grant to another defendant or to others, or may receive, proper manufacturing licenses under such patents, or under any patents lawfully owned by any of the defendants or others, upon terms and conditions fixed by the licensors; provided further that any such licensor is prohibited from requiring or imposing upon the licensees the fixing of the wholesale price to be observed by the licensee vendees; and the purchasers of such lamps from either the licensor or licensee or from the vendees of either the licensor or licensee, whether at wholesale or retail, shall not be in any manner restricted as to the price at which such lamps shall be sold to the public or to any dealer or consumer.

The defendants are enjoined from maintaining, by agreement, differentials between lamps which do not in fact differ in quality or efficiency and from allowing discounts based on aggregate purchases from different manufacturers.

The defendants are enjoined from making or enforcing any agreement with dealers, jobbers and consumers who buy from the said defendants either tantalum, tungsten, graphitized-filament or ordinary carbon-filament lamps, whereby such dealers, jobbers and consumers are compelled to purchase all of their ordinary carbon-filament lamps from said defendants as a condition to the purchase of and other type or types of lamps; and they are enjoined from discriminating against any dealer, jobber or consumer desiring to purchase tantalum, tungsten and graphitized-filament lamps because of the fact that the latter purchases ordinary carbon-filament lamps from others, and from discriminating against any dealer, jobber or consumer desiring to purchase any one or more of the above-mentioned types of lamps because of the fact that he purchases any other of the said lamps from other manufacturers of or dealers in them.

The defendants are enjoined from making discounts based on the quantity of lamps purchased by any dealer, jobber or consumer, from making such discounts on the basis of the total quantity of tungsten, tantalum, graphitized-filament or ordinary carbon-filament lamps, or the total quantity of ordinary carbon-filament lamps or any one or more of other types of lamps sold, and are enjoined from making any discounts based on the total quantity of any two or more types of lamps sold, when the result is to combine or aggregate discounts on both an unpatented lamp and a lamp patented or claimed to be patented; and the defendants are enjoined from utilizing any patents which they may have or claim to have, or which they may hereafter acquire or claim to have acquired, as a means of controlling the manufacture or sale of any type or types of lamps which are not protected by lawful patents.

The defendants are enjoined from offering or making more favorable prices or terms of sale for incandescent electric lamps to the customers of any rival manufacturer than they at the same time offer to their established trade, where the purpose is to drive out of business such rival manufacturer or otherwise unlawfully to restrict the trade and commerce of the United States in incandescent electric lamps; provided that no defendant is restricted from making any price for incandescent electric lamps to meet or to compete with prices previously made by any other defendant or by any rival manufacturer; and provided, further, that nothing in the decree shall be taken in any respect to restrict fair, free and open competition in the sale of the lamps.

The decree enjoins the defendants in suit who are licensees, namely, the Westinghouse Electric & Manufacturing Company and others above mentioned, from operating under any license contracts or agreements so far as such contracts or agreements provide that prices and terms of sale of incandescent electric lamps shall be fixed otherwise than by the licensor, or containing provisions fixing the price at which any purchaser or any vendee from a manufacturer shall sell incandescent electric lamps.

The General Electric Company is enjoined from exercising its option to purchase the capital stock of the defendant Franklin Electric Manufacturing Company or from exercising or attempting to exercise any influence or control upon that company by virtue of its option.

The decree reserves to the court jurisdiction in the case for the purpose of enforcing its provisions and also for the purpose of modifying any of its injunctive provisions as to any defendant upon the joint application of the attorney-general and such defendant.

It is ordered that the defendants be given a period of ninety days from Oct. 12 for compliance with the terms of the decree; but they are given a delay of six months from and after that date for compliance with the terms relating to the dissolution of the National Electric Lamp Company and its subsidiary companies.

On the day when the decree of Judge Killits was filed Attorney-General Wickersham made the following statement:

"The decree entered to-day by the Circuit Court of the United States for the Northern District of Ohio against the General Electric Company and about thirty or more defendants is the outcome of a suit which the government brought about six months ago to break up a combination in restraint of interstate trade and commerce in incandescent lamps.

"It appeared that the combination controlled practically 97 per cent of the electric lamp business of the country and that it was regulating by agreement prices at which all lamps were sold. The larger part of the business was done through the General Electric Company by means of its ownership of the National Electric Lamp Company, which, in turn, controlled a number of subsidiary companies, though all of these were pretending to operate as independent and competing concerns. The balance of the business was done through the Westinghouse Electric Manufacturing Company, the Westinghouse Lamp Company and a number of smaller companies named in the petition.

"The defendants by this combination not only controlled the prices at which lamps were sold by the manufacturers, but even the prices at which they were resold by jobbers and dealers, and then controlled not only the prices at which lamps covered by patents were sold, but the price at which unpatented lamps were sold, and they were enabled by the enormous power thus secured over the market to require practically all purchasers of lamps to buy unpatented lamps from members of the combination as a condition to the right to purchase patented lamps.

"In addition to this the defendants engaged in the combination had resorted to many practices contrary to fair trade in order to crush and destroy independent rivals.

"All the defendants duly filed their answers to the petition of the government, but later, after the government was prepared to present its testimony and after the decisions of the Supreme Court in the Standard Oil and Tobacco cases, the defendants in this case indicated a desire to submit to a decree. After full consideration and many conferences extending throughout the summer a decree satisfactory to the government was obtained. Accordingly, by leave of the court, the answers of the defendants have been withdrawn and the decree aforesaid entered to-day.

"By this decree the contracts and combinations entered into by all the defendants are declared to be unlawful under the Anti-Trust act, and they are severally enjoined from entering into or performing any agreements or arrangements of any nature by which the prices of incandescent electric lamps of any type or description, whether patented or unpatented, are to be sold, either at wholesale or retail.

"In addition to this general injunction there are certain specific things accomplished by the decree which are of far-reaching importance to the freedom of competition in interstate commerce, and which it is believed will establish precedents of genuine value to the government in any like cases that may arise. Among these are the following:

"First: The National Electric Lamp Company and all its subsidiary companies are ordered to be dissolved and the General Electric Company is forbidden hereafter to conduct any business in the manufacture or sale of electric lamps except in its own name.

"Second: The practice of fixing the resale price on any style of lamp, whether patented or unpatented, is hereafter forbidden, and when once a lamp has been manufactured by the owner of a patent or his licensee and sold to a wholesale or retail dealer the price at which such dealer sells to another or to the public is open to free competition.

"Third: The method by which competition in unpatented

articles has been suppressed through the use of a patented article is declared to be unlawful, and is forbidden. The manner in which this was done is fully explained in the government's bill. But, in brief, it may be stated that the practice consisted in a system of contracts with dealers, jobbers and consumers by which they were compelled to agree to purchase from the defendants all their supply of carbon lamps on which the patent had expired as a condition to the right to purchase certain lamps known to the trade as tungsten, tantalum and metalized-filament lamps, which are still claimed to be patented. By means of aggregating discounts on lamps claimed to be patented with discounts on lamps not patented, another weapon was used to suppress competition in unpatented lamps. Both these practices had the effect of continuing a monopoly on an article long after the patent had expired by tying up its sale with a patented article which the trade required.

"Fourth: The General Electric Company and each and all of the defendants engaged in the manufacture of electric lamps are enjoined from entering into or carrying out certain contracts which it has been the practice to make in the past, by which the manufacturers of bulbs, tubing and other parts necessary to a completed lamp were bound not to sell the article manufactured by them to anybody except the defendants save upon unequal conditions. The result of this part of the decree is that independent manufacturers of electric lamps will hereafter be enabled to secure the parts necessary to such manufacture without the unfair and unnatural restraint which has heretofore existed.

"Fifth: All parties to the combination are enjoined from hereafter seeking to injure the business or secure the trade of rival manufacturers by offering and making terms or prices for incandescent lamps to the customers of such rival manufacturers more favorable than they make to their established trade, though nothing in the decree is to be taken in any respect as a restraint upon fair, free and open competition.

"It may be proper to add that the investigation out of which this suit arose also disclosed eleven other patent pools of a similar nature by which the prices of various electrical devices and supplies were fixed and to which some of these defendants were parties. But since the institution of this suit all these pools have been voluntarily dissolved.

"It may further be said that the investigation also disclosed a general trade and patent agreement between the General Electric Company and the Westinghouse Electric & Manufacturing Company, the two largest electrical concerns in the country, covering substantially their whole business; but this agreement, since the institution of the government's suit, has expired by limitation and has not been, and it is believed will not be, renewed."

Vice-president B. G. Tremaine, of the National Electric Lamp Company, stated that the decree would not affect the operation of any of the plants included in the order of dissolution. The General Electric Company, he said, had purchased the stock of the National Electric Lamp Company. The latter and its subsidiaries will be dissolved, but they are all the property of the General Electric Company and Mr. Tremaine believes they can be operated by it without violating the Sherman anti-trust law. Instead of being run separately and under different names, the companies can make it plain on all their stationery and many other ways that they are owned by the General Electric Company and that everything connected with them is under its control.

The Bryan-Marsh Company in a circular letter to its customers states that there will necessarily be some changes brought about on account of the decree, but that these changes will in no way affect the personnel of the company, which will continue to render the same service, and whose methods of conducting its business will not undergo any change.

American Institute of Electrical Engineers Affairs.

At a meeting on Oct. 13 of the board of directors of the American Institute of Electrical Engineers a resolution was adopted providing for a Pacific Coast meeting of the Institute at Portland, Ore., in the month of April, 1912. Upon the report of the board of examiners eighty-six associates were elected, forty-four students enrolled and seven associates transferred to the grade of member. A university branch was authorized at the Oklahoma Agricultural and Mechanical College, Stillwater, Okla., and another at Yale University.

The law committee reported its interpretation of the provisions of the constitution providing for second nominees on the directors' ticket of nominees and gave the opinion that the request of two members of the board for the naming of a second nominee operated of itself, without further ballot, to put the name of such nominee upon the directors' ticket. The president announced the appointment of Mr. W. D. Weaver to serve as a member of the Edison medal committee for five years and also informed the board that the following members had been appointed on the United States national committee of the International Electrotechnical Commission: Mr. C. O. Mailloux, president; Dr. Arthur E. Kennelly, secretary; Messrs. Comfort A. Adams, Louis Bell, John J. Carty, Carl Hering, John W. Howell, John W. Lieb, Jr., Ralph D. Mershon, Edward B. Rosa, Charles F. Scott, Clayton H. Sharp, Samuel Sheldon, Charles P. Steinmetz and Samuel W. Stratton.

The committee appointed at the August meeting of the board to welcome and entertain Mr. S. Z. de Ferranti, president of the Institution of Electrical Engineers of Great Britain, visiting the United States, reported that it had given a luncheon in honor of the distinguished guest which, in addition to Mr. de Ferranti and the other guests of honor, was attended by nine past-presidents and fifteen officers of the Institute.

On the invitation of the International Society for Testing Materials, the president was authorized to appoint a delegate to represent the Institute at the sixth congress of that society, to be held in September, 1912. The secretary was instructed to publish with the standardization rules of the Institute the decisions of the International Electrotechnical Commission at Turin in regard to standard symbology, the direction for indicating advancement of phase in graphic diagrams of alternating-current quantities, and a résumé of the principles of the rating of electrical machinery of the leading foreign countries.

A resolution was adopted providing for a committee on electrophysics as a standing technical committee of the Institute and the appointment on the committee of the same number of members as are appointed on the other technical committees of the Institute.

In view of the resolution proposed and carried with much applause at the International Electrical Congress at Turin complimenting the American Institute of Electrical Engineers on its practice of inserting in its publications the metric equivalent value in parentheses after each expression of values in English measures, and also in view of the request of the congress that the technical societies of all countries in which the metric system is not yet official be invited to follow the example of the American Institute of Electrical Engineers, the board adopted a resolution instructing the editing committee to regard as standard practice and to continue the insertion of metric equivalents and to include in its "Suggestions to Authors" the request that the authors themselves, as far as possible, make the metric insertions in order to facilitate the work of the editing committee. It was also resolved that the Institute adopt the standard international symbology decided upon by the International Electrotechnical Commission and that the editing committee be requested to include in its "Suggestions to Authors" the request that, as far as possible,

the authors of all papers also adopt this symbology; and that the Institute adopt as the standard direction for expressing advancement of phase in graphic diagrams of alternating-current quantities the counter-clockwise direction standardized by the International Electrotechnical Commission, and that the editing committee be requested to ask the authors of Institute papers, as far as possible, to use this standard direction in diagrams prepared for publication in the Institute transactions.

The meeting closed with the adoption of a resolution, offered by Past-president Jackson, expressing the appreciation of the board of directors of the distinguished services of President Dunn, Chairman Mailloux, Secretary Kennelly, Dr. Sharp and of the president of the International Commission, Dr. Elihu Thomson, and their associated American delegates to the International Electrical Congress at Turin, in representing the Institute with gratifying enhancement of its reputation and dignity in the functions and meetings of the congress and of the International Electrotechnical Commission.

Annual Rejuvenation of the Sons of Jove.

Between three and four hundred delegates from all over the country were in attendance at the annual rejuvenation of the Sons of Jove at Denver, Col., this week. The reigning Jupiter of the order, Mr. J. F. Dostal, formerly of Denver and now of Colorado Springs, had arranged an elaborate entertainment program for the delegates. On Oct. 16 there was a smoker at the Colorado Traffic Club and the annual rejuvenation was held on Oct. 17 at El Jebel Temple, when over one hundred candidates were initiated. The rejuvenation was preceded by a parade in which the members wore the garb of the order. In honor of the rejuvenation the streets were a blaze of red light and special electrical floats of elaborate design formed a feature. The business sessions were held in the Brown Palace Hotel, where a banquet was held on Oct. 18 as the concluding function of the convention. At the business session in the morning Mr. R. W. Jaynes, of Pittsburgh, Pa., was elected Jupiter for the coming year.

Convention of Railway Signal Engineers.

The sixteenth annual convention of the Railway Signal Association was held at the Hotel Antlers, Colorado Springs, Col., Oct. 10, 11 and 12. There were over 500 registrations and the papers and committee reports were printed and bound for the meeting. The latter comprised 365 pages and had been so carefully prepared by the authors and committeemen that they went through without much discussion or objection. The reports of the committees on wires and cables, electric signaling for electric railways and on storage batteries were especially interesting. The committee on storage batteries devoted its labors to the preparation of specifications for portable cells of the all-lead type designed to be transported to central charging stations for recharging and to be used for operating electric-motor signals, control and line circuits, etc. The batteries contain from two to six cells and have capacities ranging from 40 amp-hours to 100 amp-hours. The report of the committee on wires and cables embraces specifications for lead-covered cable for circuits of 660 volts or less; specifications for underground, braided cables for circuits of 660 volts or less; specifications for lead-covered cables for 2200-volt service; specifications for copper-clad steel bond wires, and specifications for 30 per cent conductivity of hard-drawn, copper-clad, steel line wire. Mechanical, chemical and electrical tests of rubber insulation are required which are more stringent than those specified in the National Electrical Code. The insulation must show an analysis not less than 30 per cent nor more than 33 per cent of pure Upriver fine, dry Para rubber of best quality; not more than 4 per cent of solid, waxy hydrocarbons consisting of refined paraffine or pure ozokerite; not more than 0.7 per cent of free sulphur; not more than 2.5 per cent total sulphur. There must be freedom from all foreign matter, and the mineral matter shall be such as will not have a deleterious effect on the insulation.

The attendance of electrical manufacturers and their representatives was unusually large. The entertainment features were more numerous than at other meetings, probably due to the many attractions around Colorado Springs. Trips were made to Pike's Peak, the Garden of the Gods, Cheyenne Canyon and Cripple Creek. The annual baseball game of East vs. West was attended by the entire delegation.

The newly elected officers are Mr. C. C. Anthony, Pennsylvania Railroad Company, Philadelphia, Pa., president; Messrs. B. H. Mann, Missouri Pacific Railway, and F. P. Patenall, Baltimore & Ohio Railroad, vice-presidents, and Mr. C. C. Rosenberg, secretary-treasurer. Quebec, Canada, was selected as the place for the next annual meeting, which will be held in September, 1912.

Officials of the American Electric Railway Association.

The last business meetings of the thirtieth annual convention of the American Electric Railway Association were held on Oct. 13 at Atlantic City, N. J. The entertainment features of the convention lasted until that date and were concluded by an interesting aviation exhibit.

Mr. Thomas N. McCarter, president of the Public Service Corporation of New Jersey, was elected president of the association for the ensuing year. The other officials of the parent association are as follows: First vice-president,

PRESIDENT-ELECT T. N. M'CARTER.

Gen. George H. Harries, Chicago, Ill.; second vice-president, Mr. Charles N. Black, United Railroads of San Francisco; third vice-president, Mr. C. Loomis Allen, Syracuse (N. Y.) Rapid Transit Railway; fourth vice-president, Mr. Charles L. Henry, Indianapolis & Cincinnati Traction Company; secretary and treasurer, Mr. H. C. Donecker.

The new officials of the allied American Electric Railway Engineering Association are as follows: President, Mr. E. O. Ackerman, Columbus (Ohio) Railway & Light Com-

pany; first vice-president, Mr. Martin Schreiber, Public Service Railway, Newark, N. J.; second vice-president, Mr. L. P. Crecelius, Cleveland (Ohio) Railway; third vice-president, Mr. John Lindall, Boston (Mass.) Elevated Railway; secretary-treasurer, Mr. Norman Litchfield, Interborough Rapid Transit Company, New York.

The report of the committee on education was presented by Prof. H. H. Norris before the American Association on Oct. 10. The committee invited five companies last year to co-operate in an actual experiment with employees. Each company was asked to contribute a reasonable sum of money and five young men with whom the committee could conduct its experiment. The committee, Professor Norris said, believed that if a young man could be stimulated to investigate further than the actual demands of his job required he could be led to undergo a process of self-education. The committee enrolled twenty-seven students last year, and it recommends that the experiment be continued another year and that the number of students enrolled be increased to 100. It was also recommended that each student be expected to pay $5 as evidence of his appreciation of the work, and that each company be expected to pay not to exceed $35 for each student enrolled. The total expenditures for the period of the experiment averaged $22 per student.

Mr. Horace W. Flashman, who acted as instructor for the committee, stated in an appendix to the report of the committee that 227 letters were written to the boys. The students were encouraged to ask questions regarding their daily work. To the first one or two problems the answers were brief and hesitating, the boys feeling that they were walking through unfamiliar fields. At the close of the course in practically all cases the answers, although on more difficult subjects, were extended and complete.

Organization of the Gas, Electric and Railway Association of Oklahoma.

As a result of a meeting of parties interested called by Prof. Harold V. Bozell, director of the school of electrical engineering at the University of Oklahoma, on Oct. 6, the Gas, Electric and Railway Association was formed, with the following officers: President, Mr. Noel R. Gascho, manager of the Alva Light & Power Company; vice-president, Mr. Fred. W. Caldwell, manager of the Shawnee Gas & Electric Company; secretary-treasurer, Prof. Harold V. Bozell, Norman; directors, Messrs. Galen Crow, manager of the Guthrie Light & Power Company, and Paul M. Galloway, manager of the Tulsa Gas & Electric Company, each for one year; V. H. Francis, manager of the Kingfisher Municipal Electric Light & Water Plant, and L. A. Pritchett, manager of the Marlow Municipal Electric Light Plant, each for two years.

During the sitting of the committee appointed to make recommendations as to the scope of the organization, and to present a constitution and accompanying by-laws, there was a general discussion regarding the defects of the Public Utilities Association and the benefits from the proposed organization to be derived by both privately-owned and municipal-owned plants. During its existence the public of the State seemed to have an idea that the former society was some sort of political organization, or at least an organization to fight the laws and commissions, etc., which came into being at the time of statehood. The central stations had to overcome great difficulties at the time, on account of the numerous regulations they had to conform to at once, and when the managers got together in the old association and talked over these matters they were unhappily reported as combining against the public. Mr. V. H. Francis, of the Kingfisher municipal plant, showed very clearly how the proposed association could help the municipal plants and explained some of the troubles that the municipal manager has that the private manager knows nothing of. The question as to how the State organizations might be able to reach the commissioners and councilmen of different cities where there is municipal ownership was discussed and the sentiment of the municipal managers present seemed to be that in times of disagreement with superiors over matters of engineering facts and proper management they would be helped very much by the fact that their views would often be backed by acts of the association which would have much weight with the city fathers. The question of the good the society would be able to do in the way of prevention of "fool legislation" and the enactment of good legislation was brought up by Professor Bozell, who cited some instances of legislation in neighboring States which, if enacted, would have caused some sorts of business to be a joke. The point was brought out that this influence on legislation would be—and could exist in no other way—only the furnishing of facts to the legislators concerning the effects certain proposed laws would have if enacted and that the association would countenance no one bringing influence to bear to have legislation "favorable to interests" enacted. The purpose of the association would be the promotion of the interests of the members through social and scientific lines and to help, in case laws were proposed in which the association was interested, to see that these laws were based on facts.

According to the constitution and by-laws adopted, provision is made for three classes of members, namely, Class A, Class B and associates. The first is open to managers and directors of companies; the second to other employees of the same; the third to any one interested in the gas, electric or railway business or skilled therein, including the commercial men. Only the first-class members may hold office and vote. There is provision for advancement from Class B and associate membership to membership in Class A. An annual meeting is provided for.

There was present at the meeting—which was called in the Auditorium of the State Fair Grounds at Oklahoma City—a very good representation of managers of plants from all over the State, municipal as well as private interests being represented. Almost all of the large towns of the State were represented. All of the commercial men in that part of the country who knew of the meeting were present. The annual meetings will be held alternately on the east and west sides of the State—that is, one meeting will be held in what was Indian Territory and the next in what was the Territory of Oklahoma.

Following the election of officers the newly elected president delivered an address under the title "Co-operation, Not Combination," which he said should be the object of the organization. He claimed that the regulation of public utilities has come to stay and it is to the advantage of all parties for the regulated companies to co-operate with the corporation commission. Co-operation should not only exist between the association and the commission but member companies and individuals should lend the commission every assistance possible in ascertaining the facts relating to the business. The commission is the same as a court of justice, being as much the court of the defendant as of the plaintiff; it is just as much the commission of the public utilities as it is of the public. It was not created to work hardships on any class or any line of business, but to see that all parties concerned are treated fairly. So long as men of high standing and with honesty of purpose are elected to these important positions neither the public nor the public utility companies have anything to fear.

It is common knowledge among the member companies that certain plants operated by municipalities which cannot pay ordinary operating expenses give lower rates than do privately owned plants elsewhere furnishing similar service. Customers of the latter plants hear of the lower

rates and wonder why a private company cannot furnish the service at as low a rate as a municipality. They keep talking this over among themselves, aided by the demagogue politician, until they have worked up a fearful case of robbery and graft. Then they are prejudiced and the privately owned plant might sell service at actual cost, or below cost for that matter, yet in their minds the graft would still exist. This state of affairs should be gone into by the commission and the municipalities should be shown where they are operating at a loss and be required to bring the rates up where they belong so as to pay expenses, interest on the bonds, provide for depreciation, etc. The municipalities engaged in furnishing lighting service to their inhabitants should be required to keep their accounts and make reports in detail to the commissions as to income, expenses and earnings, just as is done with privately owned companies. The majority of the municipal plants would be glad of this sort of help from the commission. They would like to be placed on a paying basis, so that when a machine is burned out, transformers are lost by lightning, or the interest on their bonds falls due, they would not have to borrow from some other city funds or vote more bonds to meet these items.

By proper co-operation adverse legislation can be prevented and at the same time legislation of a just and necessary character can be enacted, such as giving the commission power to issue "indeterminate permits" during satisfactory service and giving it power to decide whether a community can best be served by two public utility companies in competition or served by one under State regulation—further, before a competitive utility can build another plant in the same community, it must secure a permit. Thus the commission is protective as well as regulatory.

Denver Electrical Show.

The second annual electrical show given under the auspices of the Colorado Electric Club was opened in the Auditorium in Denver on Oct. 14. Coincident with this year's exposition there was the annual convention of the Rejuvenated Sons of Jove in honor of which red predominated in the color scheme of the street illumination which formed a feature of the show week. An electric parade made up of 350 electrically propelled vehicles preceded the formal opening and the platoon of police forming the escort for the parade headed the procession in electric runabouts.

Many innovations were made in the street illumination. The emblem of the Sons of Jove was featured prominently in front of a number of the hotels and the portiere and stringer effects used in decorating the streets last year were again in place on the thoroughfares leading to the Auditorium. Within the Auditorium the booth arrangement was much the same as last year as was also the illumination. The mountain sunset which was the main feature of spectacular interest at the previous show was replaced by electrical dances performed by Miss H. Wallack. The electrical effects used in connection with the dances were gorgeous. Mirrors were placed around the stage on which the dances were given and the floor was of thick, clear glass through which colored light was diffused.

The freaks of high-frequency currents were repeated this year, the demonstrator being Prof. H. T. Plumb, formerly of Purdue University, who also delivered lectures during the exhibition. The entire experimental equipment of the Colorado State School of Mines was on exhibition in the section devoted to the high-frequency experiments.

All of the latest improvements and developments in electrical machinery and appliances were shown during the week. The department devoted to the heavier exhibits, such as mining and milling machinery and irrigation pumps, was unusually complete. Under the rules of the club soliciting or selling of exhibited or other articles was forbidden and nothing was offered for sale but refreshments. The membership committee of the N. E. L. A. had a booth at the show and efforts were made to increase the membership, the campaign being carried on among the manufacturers eligible for Class D membership.

Assert Electrolysis Damages Pipes and Building Structures in Chicago.

The office of L. G. McGann, commissioner of public works of Chicago, has served notice on the surface, elevated and subway electric railways of Chicago, citing instances where it is believed electrolytic damage has been caused or is now under way as the result of stray return currents from the rails. The communications are based upon reports of an investigation recently made by Mr. Raymond Palmer, a consulting engineer, who was engaged by the city to make a survey of electrolytic conditions in the downtown section and on the South Side. The report gives examples of damage caused to underground pipes, mains, buildings and bridge structures, and suggests remedies in the form of adequate return paths for the railway currents. The bridges at Clark, Wells, Dearborn and Van Buren Streets are said to have been already affected by the stray return current. According to the report, the electrolytic damage is caused by the returns from the elevated railways (which are carried on steel structures generally supposed to afford ample return path) and by the 250-volt electrified tracks of the freight tunnels of the Illinois Tunnel Company, 40 ft. below the street level, as well as by the 600-volt surface-road trolley returns.

Electrical Co-operation.

At the meeting of the Electric Club of Chicago on Oct. 11 Mr. Philip S. Dodd, secretary of the Commercial Section of the National Electric Light Association, spoke on the subject of electrical co-operation. He mentioned three agencies that may be employed to this end. One is the Sons of Jove, which is a powerful social organization which could do certain valuable work for the development of the industry as a whole. Another agency is the Commercial Section of the N. E. L. A. This body is active in promoting electrical co-operation. It has circulated 10,000 copies of its book entitled "Data on Electric Signs" and 40,000 copies of the publication entitled "Electrical Equipment of the Home." In preparing and distributing the latter book jobbers, contractors and manufacturers have co-operated with the N. E. L. A. The third agency of co-operation mentioned by Mr. Dodd is the "people's electrical page" in daily newspapers in certain cities. This co-operative advertising page is now published in seven different cities and in three of these the page is published in two different papers. This co-operative daily newspaper advertising is proving of direct value to the advertisers and also it forms the entering wedge for real co-operation among the various electrical interests. There should be a good opportunity for such advertising in Chicago.

Mr. H. L. Rogers, business manager of the Chicago *Daily News,* spoke from the viewpoint of a daily newspaper advertising man. He thinks that it will pay electrical people to advertise in the daily newspapers things of general interest. Mr. Dodd's plan appeals to the speaker as a good one. Mr. Rogers expressed the hope that his hearers would not be frightened by the expense, and said that there were several stores on State Street that spent more than $100,000 a year for advertising in a single paper.

Mr. H. H. Cudmore, of Cleveland, said that the experience of that city with co-operative newspaper advertising had been very favorable. A page is run weekly in a morning paper and there is also a page once a week in an evening paper. The central portion is occupied by electrical news and "reading matter," with the remaining space taken up by advertisements. Mr. Cudmore recommended that the same idea be adopted in Chicago and that the Electric Club take it up. Mr. A. A. Gray made a plea for organized effort in electrical development, and spoke in favor of co-operative electrical advertising in daily newspapers.

The matter of establishing daily newspaper service of this character in Chicago under the auspices of the Electric Club was referred to the board of managers, which was instructed to report to the club at a subsequent meeting.

Patents and Monopolies.

Mr. Charles A. Brown, a prominent member of the patent bar of Chicago, delivered an address on the relation of patents to pooling agreements before the Electric Club of Chicago at the weekly luncheon of Oct. 11. Mr. Brown has spoken on this important subject before, and in the issue of the *Electrical World* for March 23, 1911, page 708, there appeared an abstract of his scholarly review of the situation as delivered on a previous occasion. His speech before the Electric Club covered much the same ground. In concluding Mr. Brown said that the test of legality in this matter may be obtained, perhaps, by an examination of the question whether the patent under which the combination is effected is a valid one, with claims covering all the devices licensed under the combination. If that is the case the combination is very likely to be held to be a legal one. A feature of the situation is that Congress may wipe out the entire patent system if it wishes to do so. The people may desire to clip the wings of corporations depending on patent monopoly by this means. It would be lamentable, however, to abolish patent protection entirely, as such protection is an incentive to invention.

Mr. A. D. Curtis asked if there had been any recent change in the attitude of Congress toward design patents. Mr. Brown answered that there is a tendency among some Congressmen to attack the patent system at almost every session, but there has been no radical change in the patent laws for a long time.

Mr. Donald M. Carter, a patent lawyer, said that a patent monopoly is different from other forms of monopoly in that it is virtually a contract between the government and an inventor. The people do not realize this fact and therefore do not do justice to patent monopoly, confounding it with odious monopolies of other descriptions. The government cannot lessen the value of a patent and live up to the terms of its contract. If the facts were fully understood it might be possible to get legislation that would protect inventors and at the same time prevent patents from being used for wrongful purposes.

Mr. F. P. Vose asked for information about the German patent system and Mr. Brown said that there were many points of similarity between patent practice in Germany and the United States. It is believed, however, that, speaking generally, Germany is not opposed to trade combination. A vote of thanks was extended to Mr. Brown for his instructive address.

October Meeting of A. I. E. E.

At a meeting of the American Institute of Electrical Engineers held in New York on Oct. 13 Mr. B. G. Lamme presented a paper entitled "A Theory of Commutation and Its Application to Interpole Machines." The author called attention to apparent contradiction of facts in the usual mathematical assumptions made in treating the problem of commutation. According to the usual theory, during the commutation of the coil the local magnetic flux due to the coil is assumed to be reversed, although it is apparent that in the zone in which the commutation occurs certain of the magnetic fluxes may be assumed to be practically constant in value and direction during the entire period of commutation. The author described a method of dealing with the problem of commutation based upon considering the armature flux as a whole as set up by the armature ampere-turns. The theory is based upon the broad principle of the revolving conductors cutting across the stationary armature field set up by the armature winding, and thereby generating an electromotive force in the short-circuited coils which is proportional to the product of the revolutions, the flux which is cut and the number of turns in series. The usual reactance voltage due to the reversal of the local flux in an individual coil is not considered, although its equivalent appears under another form.

The author stated that the field distortion has practically nothing to do with the problem. The distorted field magnetism is simply a resultant of the no-load main field flux combined with that due to the armature winding, therefore the two components of the distorted full-load field are the no-load main field, which is fixed in space and is usually practically constant, and the armature field, which is also fixed in space, but varies with the load. If the brushes are set in a certain position with respect to the no-load field, then as this component of the resultant full-load field is practically fixed in space and in value it has no variable influence on the commutating conditions. The true variable element which does affect the commutation is the armature flux, and it is this flux which is the basis of the author's theory of commutation. In the case of the interpole machine a small pole is placed midway between two adjacent main poles for the purpose of setting up a local magnetic flux under which the armature coil is commutated. The resultant magnetic flux and electromotive forces may be assumed as made up of two components which can be considered singly. One of these components is that which would be obtained with an armature magnetomotive force alone acting along the various flux paths, including the interpole, and the other would be that which would be obtained with the interpole magnetomotive force alone, the armature magnetomotive force being absent. When the two components are superimposed the interpolar flux due to the armature magnetomotive force is in direct opposition to that due to the interpole magnetomotive force, and therefore only the electromotive force due to their difference is effective. The interpole magnetomotive force can be considered as consisting of neutralizing ampere-turns, which are effective in overcoming the armature magnetomotive force, plus magnetizing ampere-turns, which produce the resultant interpole field.

When the different armature electromotive forces are determined for the whole period of commutation and then superimposed the resultant electromotive force indicates the flux distribution required under the interpole. The author gives equations for representing the various electromotive forces and fluxes required. According to the author's treatment the exact balance between the interpole and armature magnetomotive forces gives the best condition. He remarks that from certain standpoints this relation is the correct one, but in practice usually a slight excess of the interpole strength, or over-compensation by the interpole, is advantageous. The method described has been applied to a large number of direct-current machines, including high-speed generators, turbo-generators, direct-current railway motors, moderate-speed and low-speed generators of all ratings, industrial motors of various design, including adjustable-speed motors and machines with half as many interpoles as main poles. The agreement between

the calculated results and test data has been found to be very close.

In his introductory remarks President Gano Dunn outlined certain work accomplished by the International Electrotechnical Commission at the International Congress of Turin. He called attention to the fact that the International Electrotechnical Commission has suggested that an international congress be held at San Francisco in 1915. As a result of the work of this commission the English have agreed to substitute *I* for *C* as the symbol for current, and the Germans have agreed to substitute *R* for *W* as the symbol for resistance, so that in the future Ohm's law will be expressed by the symbols *I, E* and *R,* which have been in common use in America for a number of years. The commission has recommended that in the graphical representation of alternating-current quantities the counter-clockwise direction of rotation is to be employed. This method is in conformity to the former usage in France, Italy, Sweden, Norway, Russia and Japan, and it corresponds with the usage of about one-half of the writers in Germany and the United States. The plan adopted by the American Institute of Electrical Engineers of putting metric equivalents of English measures in parentheses after the expressions of value was indorsed, and all technical societies in all countries have been asked to follow the example of the A. I. E. E. in this respect.

The discussion on Mr. Lamme's paper was opened by Mr. H. F. T. Erben, of Schenectady, N. Y. He remarked that although the formulas take into account many things that are frequently neglected in commutation formulas, yet they can be applied only when constants are inserted from experience. He stated that if a turbo-generator running at about 2000 r.p.m. when not provided with compensating windings will carry from 700 to 800 per cent normal load without flashing over, then when it is fitted with compensating windings it will carry probably ten or twelve times normal load without flashing. Photographs taken at the moment of short-circuit indicate that gas is thrown out ahead of the brush. This gas is of very high electrical conductivity, so that the arc follows the gas and is carried around the machine with the gas as a conductor. That the production of gas is an important element in commutation is shown by the fact that the overload which a machine can carry is reduced by probably 50 per cent when one-half of the brushes are removed from the commutator. Although there exists a general impression that the problems of the direct-current machine are very simple, the fact is that commutation is one of the most complex problems that electrical engineers have to handle.

Dr. George L. Hoxie, of New York, stated that the direct-current generator is really an alternating-current machine, and involves all of the problems of the latter machine, and in addition thereto the problem of obtaining continuous current from coils in which an alternating electromotive force is produced. He claimed that it is not proper to consider separately the magnetic fluxes produced by different magnetomotive forces acting upon a common magnetic material, on account of the variation in reluctance of this material. Under load conditions the armature currents superimpose their magnetomotive forces upon the magnetomotive force of the field current, the resulting magnetomotive forces producing a resultant flux which is not the geometrical sum of the fluxes that would be produced by the two magnetomotive forces acting separately. Unless the machine is arranged with a strong magnetic field and liberal air-gap and operated with saturation in the pole tips, pole faces and armature teeth, there will be great field distortion and bad commutation. So far as concerns commutation, it is desirable that during the time the coil is short-circuited by a brush it should have generated within itself an electromotive force opposed to the current that the particular coil carried a moment earlier. Moreover, this electromotive force should be of sufficient value to bring the initial current to zero and produce a new current equal in value and opposite in direction. Dr. Hoxie called attention to the work of Prof. Harris J. Ryan, who designed and patented a pole-face winding some twenty-one or twenty-two years ago. He expressed the opinion that such a pole-face winding or some modification of it may again be employed for obtaining improved commutation conditions.

Mr. H. M. Hobart, of Schenectady, claimed that it is advantageous to have as large a neutral commutating zone as possible, which result can be obtained by employing a fairly small pole arc with a considerable distance between pole tips. The introduction of the interpole has tempted designers to decrease the number of commutator segments, with results which have not always been satisfactory. With a fair value of average voltage between the commutator segments the enormous armature reaction which the use of interpoles renders possible causes the maximum voltage between segments to reach in cases even five times the average voltage. The result in such cases may be a maximum electromotive force of perhaps 60 volts between adjacent segments. A voltage of such a high value is very apt to result in trouble at the commutator. There are many aspects of commutation that cannot be worked out theoretically. For example, although commutation formulas ordinarily neglect the fact, it is known that the grooving out of the mica between commutator segments results in a saving of from 5 per cent to 10 per cent, and possibly up to 15 per cent. Improvements of the same general nature, which are usually ignored in theoretical considerations, can be obtained by employing improved types of brush holders and by certain mechanical changes, including the rigidity of the commutator.

Prof. Malcolm MacLaren, of Princeton, N. J., discussed in detail the effect of employing fractional-pitch windings with interpole machines, and claimed that the effect of a variation in the pitch of the winding is small, provided account is taken of the neutralization of the armature magnetomotive force in the chorded zone. He expressed the belief that the method of analysis proposed by Mr. Lamme is applicable more strictly to interpole machines where the interpole flux is neutralized and fractional-pitch windings are used, than it is to non-interpole machines using full-pitch windings.

Prof. Comfort A. Adams, of Cambridge, Mass., showed the conditions under which the author's assumption of a stationary commutating flux through which the armature coils move is applicable in practical machines. He stated that the assumption is absolutely legitimate in the limiting case when the number of slots and number of segments under the brush are very great. With a small number of armature slots and armature segments there is a variation in time and space in the distribution of the magnetomotive force throughout the commutating zone, so that it is incorrect to consider the fluxes as stationary throughout this zone. In any case, however, it is proper to consider that a flux varying in value travels with the core, as is done according to the usual method of calculation of the local armature reactance. Although there are certain objections to the use of the short air-gap, yet in so far as the interpole machine is concerned the length of the air-gap has no influence on the commutation. Prof. Adams mentioned the fact that the air-gap in a certain machine had been decreased from its normal value of a little over 0.125 in. down to 0.02 in. with absolutely good performance so far as commutation was concerned.

Prof. C. F. Scott, of New Haven, Conn., said that the paper possesses an element of much value, in that the method of analysis depends upon physical relations rather than upon mathematical representation. The author has considered the problem of commutation as one relating to the cutting of a stationary magnetic field by moving conductors, rather than the performance of a conductor sta-

tionary with respect to the armature core around which the flux varies. He commended the paper as being an excellent example of the physical rather than the mathematical method of handling engineering and design problems.

Mr. James Burke, of Erie, Pa., called attention to the desirability of employing full-pitch rather than fractional-pitch windings with commutating-pole machines. In machines with commutating poles the coil throw is sometimes decreased to as low as 70 per cent pole-pitch. An armature thus wound does not operate as well with the interpole field construction as does an armature provided with full-pitch windings. Although not often taken into consideration in commutating formulas, the width of the mica is an important element in commutation. In the ordinary machine the mica has a width of about 1/32 in. In special cases the width has been increased to 3/8 in., with the result that machines which would not otherwise have operated have given excellent service. In certain cases if the usual theoretical criterion of commutation is applied the machines would seem to be impossible of operation, yet on account of the use of extra-wide segments such machines are found with commutators in perfect condition after continuous service for many years. Another point of considerable importance is the number of commutator bars per slot. The performance of a machine equipped with interpoles varies largely with the number of coils and commutator bars per slot, although this fact is frequently neglected in commutation theory.

Mr. C. E. Wilson, of Pittsburgh, displayed a number of charts showing the performance of coils and brushes under commutation. The curves indicated that a machine should be slightly over-compensated in order to minimize the current density under the leading brush-tip. The curves also indicated that certain machines which are fully compensated at, say, one-half load are under-compensated at overload on account of saturation in the interpole circuit.

Progress of Construction Work for Keokuk Water-Power Development.

Advantage may be taken of the fact that a large party of St. Louis engineers and electrical men inspected on Oct. 14 the hydroelectric plant in process of construction for the Mississippi River Power Company on the Mississippi River at Keokuk, Ia., to give a brief account of the progress of the work as exhibited on that date. The plant has now reached a stage when its magnitude impresses the most casual observer, while the admirable efficiency of the construction methods elicits the praise of visiting engineers. The power station will have an initial rating of 150,000 hp, with ultimate rating of 240,000 hp. It is said to be, and probably is, the largest individual hydroelectric undertaking in the world. It will represent, when completed, it is reported, an expenditure of $17,000,000.

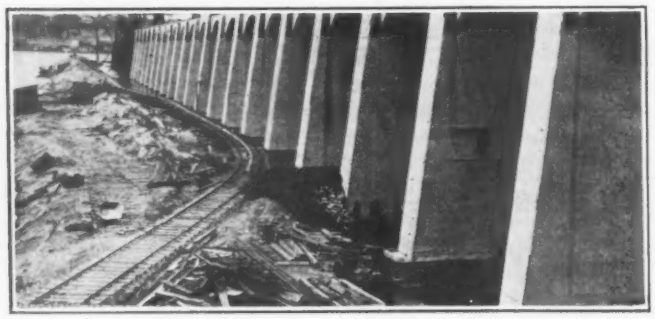


Fig. 1—Down-Stream Side of Keokuk Dam.

St. Louis, distant about 140 miles from Keokuk in a straight line, is greatly interested in the development, for the electric-service and electric-railway interests of the city have contracted to take 60,000 hp. The inspection party of Oct. 14 was made up of members of the St. Louis League of Electrical Interests and the Engineers' Club of St. Louis. It consisted of sixty-three gentlemen, among whom were a number of engineers of prominence, including Mr. H. H. Humphrey, president of the League of Electrical Interests, and several officers of the Union

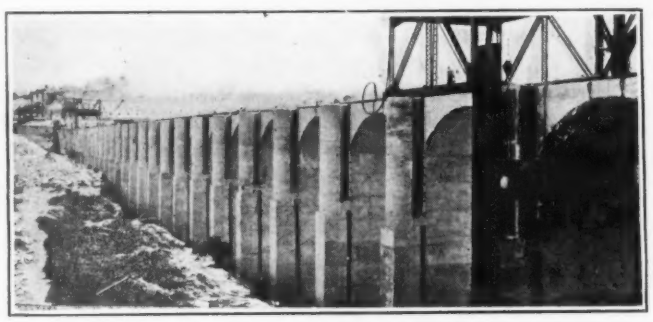


Fig. 2—Present Appearance of Keokuk Dam from Up-Stream Side.

Electric Light & Power Company, of St. Louis, as Mr. H. Spoehrer, secretary; Mr. John Hunter, chief engineer; Mr. S. B. Way, electrical engineer, and Mr. F. D. Beardslee, commercial engineer. The party traveled on a night train and spent all day in Keokuk, where it was taken in charge by the Mississippi River Power Company, represented by Mr. Hugh L. Cooper, vice-president and chief engineer of the company. The visitors spent the forenoon inspecting the work on the dam, which extends out from the Illinois side of the river, and the afternoon at the power-house site, which is on the Iowa side. The engineers were entertained both at luncheon and at dinner at the Riverview Club and the Hotel Keokuk by the Mississippi River Power Company and, with delightful weather, their visit was highly instructive and enjoyable.

In a brief news account of the status of the work, such as this, it is not necessary to attempt a general description of the Keokuk water-power development. A number of articles on the subject have appeared in the *Electrical World*. In the issue of Feb. 10, 1910, page 337, there was an interesting account of the history of the enterprise. An illustrated advance description was given in the issue of May 19, 1910, page 1287, and as late as Aug. 5, 1911, page 331, there was an illustrated progress report. A number of other references to the work have appeared from time to time. So rapidly has construction been advanced, however, that the work represents quite a different appearance in a few months. The pictures given herewith, all recent photographs, give a much better idea of the work than any others that have been published heretofore.

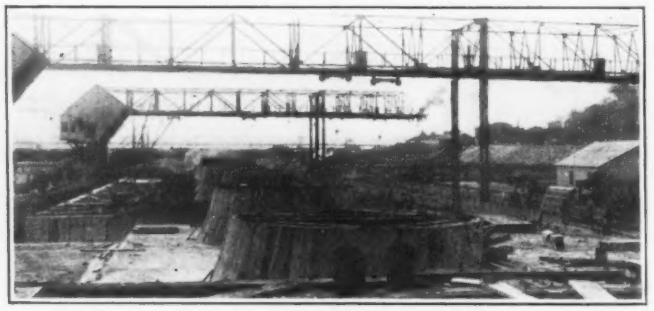


Fig. 3—Power-House Site, Showing Forms for Draft Tubes.

In outline it may be said that the dam will be 4600 ft. long, extending across the Mississippi River from Keokuk, Ia., to Hamilton, Ill. At this point the bed of the river is solid rock, and the adjoining bluffs furnish stone of a quality suitable for crushing as an ingredient of concrete.

The conditions are, therefore, very favorable. The dam proper is 46 ft. high above the average level of the river bed. It will consist of 119 monolithic concrete arches supported on concrete piers. Seventy of these arches have now been built and Fig. 1 gives a good idea of the structure from the down-stream side. Fig. 2 is a recent picture of the dam from the up-stream side, showing, at the arch on the extreme right, some of the steel forms for piers and arches in position. At right angles to the main portion of the dam, near the Iowa shore, is the power house, which is an integral part of the dam and will be 1700 ft. long. The dam will furnish a head of from 21 ft. to 35 ft., and this head and the immense volume of water available will be used to operate an initial installation of fifteen 10,000-hp hydroelectric units consisting of vertical-shaft turbine water-wheels and alternating-current generators.

Below each arch in the main portion of the dam there will be a spillway of concrete, with a massive steel controlling gate above it. The arches are 36 ft., center to center, and 30 ft. wide in the clear. The width of the dam is 43 ft. at the bottom and 36 ft. at the top. The foundations of the piers are anchored 3 ft. in bed-rock. The visitors were shown how a cofferdam is built on the up-stream side of the dam; how the water is pumped out, the rock drilled for foundation excavations and the concrete footings put in; how the steel forms are built up on these foundations by bridge workers and how the concrete is poured by means of steam locomotives hauling one large

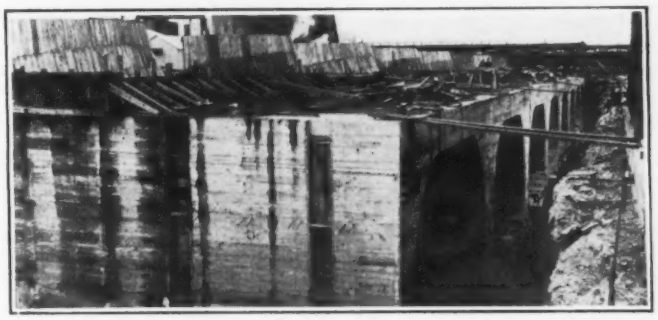


Fig. 4—View of Power-House Site, Showing Discharge Openings from Turbine Draft Tubes.

bucket from the mixing mill on shore, the buckets being handled and dumped at the end of their journey by a cantilever crane running out on the completed structure with a 150-ft. overhang; and, finally, how the whole cycle of operations is repeated as the work progresses, the cofferdam being removed and the water being allowed to run under the finished arches until the spillway construction is begun. Communication between the men in charge of the pouring of concrete and the crane operator controlling bucket travel is maintained by telephone.

The concrete used in the spillway section is of 1:3:5 mixture. There are large stone-crushing and mixing plants on both sides of the river, those on the Illinois side being used for the straightaway section and those on the Iowa division being used for the power-house site and the controlling works for the government canal for navigation. Incidentally the building of the dam will improve navigation at the Des Moines Rapids of the Mississippi River, as the present canal, with its three locks, will be replaced by a larger canal and a single lockage into the broad, deep lake that will be created. Likewise, it may be remarked that it is believed that the raising in level of the river above the dam will be observed as far north as Burlington, Ia., 60 miles away, as the river winds. The present depth of the river at Keokuk is about 6 ft., reading, perhaps, 10 ft. in spots. For a number of miles the level of the present tracks of the Chicago, Burlington & Quincy Railroad, on the west side of the river, will be under the new water level, and a part of the work is the relocating of these tracks. Many acres of land will be flooded, of course, and have been purchased or condemned.

Construction work is done largely by compressed air, although electricity is generated for lighting. There is a temporary power plant on each side of the river. On the power-house site the workmen are engaged in blasting out the wheel pit and erecting the massive concrete construction surrounding the draft tubes for the turbine water-wheels. This work is being done in the bed of the river, the water being diverted by a well-built cofferdam. The draft-tube construction is particularly impressive and interesting. There will be fifteen draft tubes for turbines in the initial installation. Each will be 18 ft. in diameter at the top and will curve down and flare out to enormous discharge openings 20 ft. high and 42 ft. wide. These openings will be beneath the level of the water below the dam, the river acting as a tailrace. Fig. 3 is a view showing the work on the power-house site. The wooden forms for the tops of several of the draft tubes are plainly shown, as well as two of the large cantilever cranes used in construction work. Fig. 4 is another view of the draft-tube construction, but this picture is intended particularly to show the great openings of the discharge chambers.

Contracts have been awarded for turbine water-wheels made by the I. P. Morris Company, of Philadelphia, and the Wellman-Seaver-Morgan Company, of Cleveland, and for vertical-shaft generators made by the General Electric Company. The 10,000-hp turbines will be mounted directly above the draft tubes and will be surmounted by the 7500-kw generators. The latter will turn at 56 r.p.m. and will generate three-phase, 25-cycle alternating current at 6600 volts. The power house will be, when complete, 1700 ft. long, with twenty-four, or possibly thirty, generating units. It will be 123 ft. wide and 133 ft. high. Transmission to St. Louis will be effected at 100,000 volts.

About 500 men are now employed in the construction work and the company maintains a clubhouse for the officers and a hospital for the men. The work is being carried on rapidly, but without confusion or bustle, and it is now expected that the initial generating equipment will be ready for service in July, 1913. The Stone & Webster interests are prominent in the Mississippi River Power Company and will probably operate the plant when it is completed.

Panama Canal Electric Towing Locomotives.

The official weekly publication of the Isthmian Canal Commission, *The Canal Record*, which is printed at Ancon, gives an account of the electric locomotives which will tow ships through the locks. Specifications have been sent to Washington in order that bids may be asked for the forty locomotives that will be required for the locks at Gatun, Pedro Miguel and Miraflores. The system of towing outlined in the specifications is the invention of Mr. Edward Schildhauer, of the canal engineering staff, and a patent has been applied for, the government having the right to use the patent without remuneration. Two bids will be called for, one for one locomotive for test purposes and the other for the remaining thirty-nine, in case the first is satisfactory.

The system of towing provides for the passing through the locks of a ship at the rate of 2 miles an hour, the vessel being held steady between four lines of taut hawsers. A ship will come to a full stop in the forebay of the locks, where four hawsers will be attached to it, two forward on either side and two aft. At their other ends these hawsers will be attached to the windlasses of four towing locomotives operating on the lock walls, two forward towing and two aft being towed by their hawsers, thus holding the ship steady. The locomotives will run on a level, excepting where they pass from one lock to an-

other, where they will climb heavy grades. Between the lower and intermediate locks at Gatun, for example, there is a difference in elevation of 29 ft. 7 in., and, in order to save concrete, this ascent is made in the shortest feasible distance. The horizontal distance from the point of tangency on the lower lock wall to the point of contact on the wall of the intermediate lock is 106½ ft. The vertical

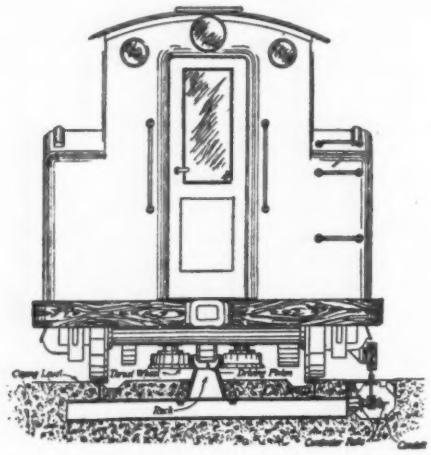


Fig. 1—End View of Electric Locomotive.

curve has a radius of 100 ft. and the maximum grade is one on two.

There will be two systems of tracks, one for towing and the other for the return of the locomotives when not towing. The only cross-overs between the tracks will be at each end of the locks, and there will be no switches in the rack road. The tracks will be of the 5-ft. Panama railroad gage, laid with 90-lb. Bessemer steel rail on Carnegie steel ties, each tie anchored into the concrete by a bolt on the side farthest from the lock chamber. On the center wall there will be two towing tracks with one return track between them, and on each side wall a towing and return track. The towing tracks will have a center rack throughout, and the locomotive, while towing, will always operate on this rack. On the return tracks, at the incline between locks, they will also operate on racks, but elsewhere they will run by friction. The racks will be of cast steel, so formed that lubricant will not drop upon the concrete and that water will not be held in the interstices, this latter precaution being taken against the breeding of mosquitoes. The distance from center to center of adjoining teeth is 3.13 in. After hauling the ship through the last gates and into the forebay, the locomotives will coil their cables and return to await another ship, or will take hold of a vessel going in the opposite direction and tow it through.

Each locomotive will consist of three parts, as shown by the drawings reproduced on this page—two tractors and, between them, a windlass. The windlass will not be mounted upon a truck, but will be supported by two arms extending on each side from either end and resting on bearings immediately over the adjacent wheels of the tractors. The ends of the arms will be equipped with rollers to permit free horizontal movement of the members when the locomotive is rounding a horizontal curve. The windlass is joined to the tractors by a drawbar and trunnion which have the effect of a universal joint and permit free movement of the parts when the locomotive is on a vertical curve.

TRACTORS.

The tractors will be alike in every particular, each consisting of a four-wheel truck upon which are mounted a motor and a control apparatus. They will run as rack or friction locomotives at the will of the operator, and the whole locomotive can be controlled from either cab.

While towing, and on the inclines between the locks, the tractor will run as a rack locomotive. Motion is communicated from the motor to the rack pinions by means of a system of gear reduction in which there are no clutches. There is absolutely no means of disconnecting this train of gears, and, as a result, the rack pinions are in motion only when the motors are. A solenoid brake, which closes upon a brake wheel whenever the current is cut off from the motors, provides against accident in case the current should be cut off while the locomotive is on one of the inclines. In such an event the locomotive would come to a stop instantly and be held there until the brake should be released. The rack pinions are of quill construction and are so mounted upon the back axle of each truck that the rack pinion will run free from the motor when the locomotive is on the return track and traveling by friction.

For traveling by friction the tractors will be fitted with jaw clutches, which will connect the traction motors with the driving wheels. These clutches will be operated by solenoids. The locomotive, when operating by friction, will move at a rate of 5 miles an hour.

The electrical equipment for each tractor will consist of one traction motor with control apparatus. The motor will have a full speed torque of 840 lb. at 1 ft. radius, full load speed, at no less than 470 revolutions per minute, and will be capable of developing not less than 75 per cent greater torque for a period of one minute. Alternating current will be used with the effect that synchronous speed will be maintained on all the locomotives in a tow. The motor will be three-phase, induction, totally inclosed, moisture-proof, high torque, or mill type, 25 cycles per second, with 220 volts between lines. The motors on the tractors of each locomotive will be operated in parallel and controlled by resistance in the secondary circuit, accomplished by contactors in the primary and secondary

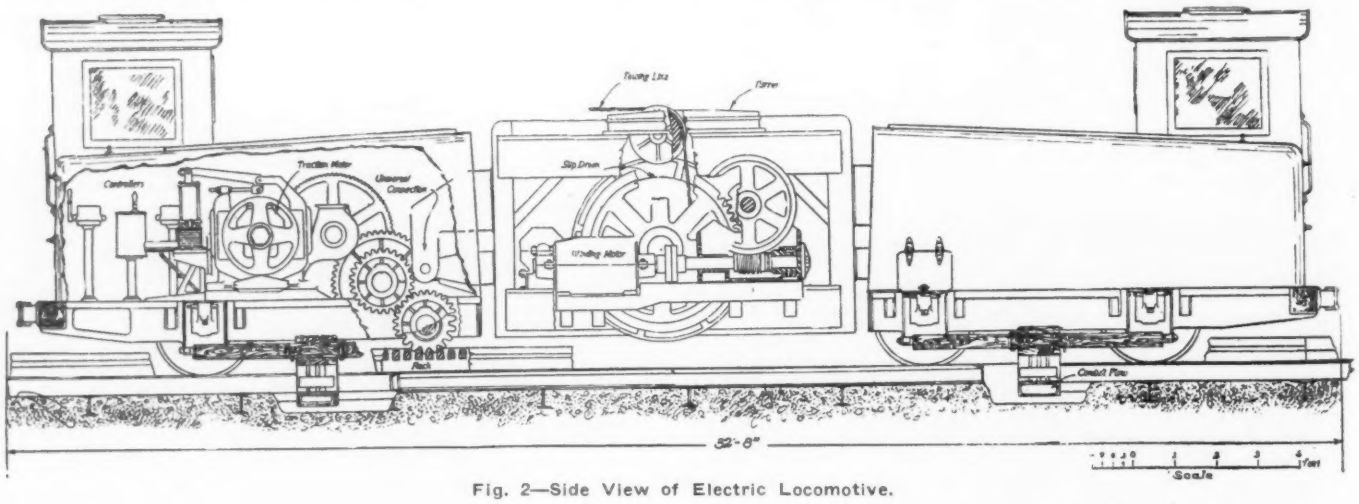


Fig. 2—Side View of Electric Locomotive.

circuits operated by master controllers, one in each cab. There will be not less than seven energy points in each direction, and between these and the braking position there will be a coasting point, so that when energy is turned off from either forward or reverse direction there will be available a coasting point before the braking position is reached. The master controllers will be of the drum type, one for each tractor.

Energy will be collected by each tractor by means of a plow carrying two contact shoes, each operating on a separate contact rail carried in an open conduit, one for each of two phases, while the third phase will be carried by both track rails. The maximum load that will be thrown upon the traction motors will occur when the locomotive is ascending the inclines between the locks, and this will be greater than the load of towing a ship. Inasmuch as weight is not required for tractive effort, the whole locomotive will be of as light construction as possible, the estimated weight being 70,000 lb.

WINDLASS.

The third part of the locomotive will be a windlass for hauling in or paying out the towline, and motors to drive it. The drum will be 18 in. in diameter. A friction clutch will provide against its ever sustaining a pull of more than 25,000 lb. Two speeds are provided for, one for coiling in the line under load at a rate of 10 ft. a minute and the other for coiling it when not under load, at a rate of 200 ft. per minute. Rotary switches in the cabs of each tractor will control the movement of the windlass.

There will be two motors, one for operating the windlass under load, and one for the rapid coiling of the hawser. The windlass motor will have a full-speed torque of 120 lb. at 1 ft. radius, will be capable of 50 per cent greater torque for one minute, and will have a full load speed of not less than 630 revolutions per minute. The coiling motor will have 30 lb. torque at 1 ft. radius, be capable of exerting 50 per cent greater torque for one minute, and will have a full load speed of 630 revolutions per minute. These motors will be of the squirrel-cage type, but otherwise will have the same classification as the motors in the tractors.

The towing line will pass through a sheave in a revolving turret, which will permit it to rotate easily in a horizontal plane, so that the line load may always be directly on the guiding sheave. The tow line will be of plow steel wire, composed of six strands of thirty-seven wires each, will have a hemp center and will be 1 in. in diameter. The wires must have a tensile strength of not less than 225,000 lb. per square inch and the hawser must have an ultimate breaking strength of not less than 70,000 lb. There will be a 4-ft. loop at the ship end, and the length of the line from the center of this loop to the drum of the windlass will be 215 ft.

All the machinery, for both windlass and tractors, will be housed in a steel casing. The housing of the windlass will consist of a steel frame covered with 3/16-in. steel plate. The top sheeting must be capable of standing a strain of 85 lb. per square foot and the upper side edges of the housing must be capable of sustaining a concentrated load of 12,000 lb., which may be placed upon it when the tow line is used to warp a vessel up to the lock wall, when the line is at right angles to the locomotive and the chock of the ship is considerably below the locomotive.

Electrical Machinery and Transformers.

As previously noted in these columns, the Turin International Electrical Congress included eight sections for the discussion of technical subjects. Below are given abstracts of the seven papers presented in Section I, which dealt with electrical machinery and transformers.

MECHANICAL AND ELECTRICAL CHARACTERISTICS OF LARGE, HIGH-SPEED GENERATORS.

In the introducton to a résumé of the present state of the art of high-speed generator design, Dr. Hans Behn-Eschenburg traced some of the most important epochs up to the time of the Paris Exposition, and then he contrasted practice at that time with present practice. At Paris the largest generator was a 3000-kw, 83-r.p.m., 6000-volt machine, and the general opinion at that time was that low-speed practice had come to stay. The success of the turbine forced the electrical designers to abandon that type and to develop an entirely new kind of machine.

Most improvement in the electrical practice has been in the extreme refinement of the details and in the use of superior materials. By using a larger number of small slots, by laminating and properly shaping the pole shoes, by subdividing the conductors, by employing effective damper windings, by locating the field and armature windings so as to get minimum leakage, and by using sheet steel with low specific losses, it has been possible to increase the effectiveness of the material, thereby increasing the specific output without increasing the losses. The result is that the output per unit weight at a given speed has in some instances been doubled within the last five years. The cylindrical form of revolving field structure, first employed by Mr. C. E. L. Brown in 1901, has been developed until now it constitutes one of the most important features of modern construction. With this type of field structure it is comparatively easy to attain any output from 100 to 20,000 kw for 25 and 50 cycles, with two, four or six poles. The number of ampere-turns per pole can be as high as 80,000. Moreover, the uniform distribution of the windings over the surface promotes efficient ventilation and reduces the difficulties of balancing.

In two-pole machines of output from 100 kw up the cylindrical structure is cheaper than that with projecting poles, but for four, six and eight-pole machines the latter has the advantage. However, when the output reaches 1000 or 2000 kw per pole, the cylindrical form comes to its own.

In direct-current, high-speed machines the limit set by commutating has been raised to about 16 volts per bar by using commutating poles and compensating windings. The commutating-pole machine was described in full by Menges in 1884, and yet there was no machine of this type shown at the Paris Exposition, all development along this line having taken place in the last eight years. Nevertheless, the size of direct-current generators is still limited by peripheral speed and the surface of the commutator.

Following the general discussion, the author gave data and formulas for determining the principal mechanical and electrical dimensions of high-speed alternating-current and direct-current generators, as well as formulas and rules for estimating the ventilation, heating and losses. These instructions are followed by actual examples, one being a 4000-kw, 3000-r.p.m., two-pole machine, and the other a 12,500-kva, 1500-r.p.m., four-pole machine.

The author concluded by giving data on a number of modern machines, which tend to show that the upper speed limit from the point of view of economy has been exceeded and that the best economical results for machines between 500 and 15,000 kva are attained at about 1000 r.p.m. With the direct-current machine, aside from the fact that the highest speeds are impossible of attainment, actual practice was indicated in the tables showing that the economical speed lies far below the range of turbine speeds. The design of gear reduction has been greatly improved, and their employment in this connection offers a way out of the difficulty.

Dr. Behn-Eschenburg's paper was discussed by Dr. S. P. Thompson, Prof. C. Feldmann and Messrs. E. Brunswick and C. Carli.

REPORT ON MOTOR-GENERATORS, CONVERTERS AND RECTIFIERS.

A report by Dr. S. P. Thompson related to that class of dynamo-electric machinery the object of which is to change electrical energy from one form into another form. The author showed that there is a transition of construction from type to type, and described briefly the following principal types: Motor-generators with two field-magnet systems and two armatures, motor-generators with one magnet and two armatures, motor-generators with one magnet and one armature having two independent windings, synchronous converters, cascade converters, revolving-field converters, rectifiers, frequency changers, phase shifters and auto-converters.

Attention was called to the fact that modern opinion favors the use of synchronous converters rather than motor-generator sets, the objections initially urged against the converters having been largely overcome. The cascade converter, which consists of a combined induction motor and synchronous converter mechanically arranged as one machine and electrically connected in series, is now usually built as a twelve-phase machine in the rotor part, and is provided with commutating poles on the field magnet.

Particular attention was paid to the so-called auto-converter, which is the most recent type of machine developed for the purpose indicated. It resembles in many respects the well-known split-pole synchronous converter, but differs therefrom in that it may be employed for converting from direct current of one voltage to direct current of another voltage. The field magnet is constructed with twice as many polar projections as there are poles in the windings of the armature, the magnet poles being arranged in pairs of the same polarity. The machines may be arranged for use as step-down, direct-current converters, as voltage regulators, to convert from variable current at constant voltage to constant current within a limited range, or as synchronous converters, affording regulation of the continuous voltage without affecting the power factor on the alternating-current side. According to the last-mentioned arrangement the machine is the ordinary split-pole synchronous converter. When used as a purely direct-current machine it is provided with two separately insulated sets of brushes, one set being arranged for one voltage and the other set for an entirely different voltage. The electromotive force produced between one set of brushes can be varied independently of the electromotive force between the other set, on account of the splitting up of the resultant magnetic fields. By proper excitation of the coils placed on the separate magnetic circuits, the machine can be arranged to operate as a variable-speed generator, which will furnish an approximately constant voltage at one pair of brushes, independent of the speed of rotation.

Dr. Thompson's report was discussed by Messrs. Brunswick, Routen and Mouchard.

SOME CHARACTERISTICS OF THE CASCADE CONVERTER.

The cascade converter was discussed and compared with the synchronous converter and the motor-generator in a paper by Mr. H. S. Hallo, which in the absence of the author was read by Prof. Clarence Feldmann. This type of machine was invented in 1902 and now there is in operation an aggregate rating of 150,000 kw. In efficiency it approaches closely the synchronous converter. For instance, comparing machines of 1000 kw and 50 cycles, the efficiencies are as follows: Synchronous converter alone, 95.2 per cent; synchronous converter with transformer, 93.5 per cent; cascade converter, 92.5 per cent; motor-generator, 89.5 per cent. On the score of price the cascade converter again stands between the motor-generator and the synchronous converter, it being but slightly more expensive than the synchronous converter.

With respect to regulation, the cascade converter surpasses the synchronous converter, but is not as good as the motor-generator. In order to keep down the wattless current in the stator winding which would be caused by regulation of the direct emf, the leakage reactance on the alternating-current side is made great by closing the slots. By suitably dimensioning the wedges used to close the slots the reactance can be made to decrease with increasing load on account of the saturation of the wedges, and in this way a machine can be so designed as to be strongly over-compounded and yet operate at unity power-factor between three-fourths load and full load.

The cascade converter is less susceptible to hunting than the synchronous converter. It also has a distinct advantage over the synchronous converter and the synchronous motor-generator in starting, since it can be started from the alternating side almost as easily as an induction motor. The synchronous motor-generator naturally has the best power-factor characteristics; however, the cascade converter is better in this respect than the synchronous converter.

In natural commutation qualities the synchronous converter has the advantage, but it is not at all well adapted to the use of commutating poles. The cascade converter, while not quite so good as the synchronous converter, is better than the direct-current generator in its inherent commutation, and lends itself readily to the use of commutating poles. The author also shows that series boosters used with synchronous converters react unfavorably upon commutation and render the use of commutation poles even less effective than they would otherwise be. The cascade machine gives the same emf regulation without a series booster.

Mr. Hallo's paper was discussed by Messrs. Brunswick, Sarli and Eichel.

FREQUENCY TRANSFORMATION.

A paper on frequency transformers, by M. Paul Bunet, was, in the absence of the author, read by Mr. E. Brunswick. The author classifies the uses of frequency transformers and briefly reviews the present state of the art in each group.

The first group includes transformations from one constant frequency to another such as are necessary when systems of different frequencies are operated in conjunction with one another. The usual method here employed is the synchronous motor-generator set, although the induction motor-synchronous generator set is also used. It is pointed out that these two kinds of machines cannot be operated in parallel, since in such event the synchronous set will carry all the load.

Another method which has been used is based on the fact that an induction motor with its primary connected to a source of given frequency and its rotor driven by another motor will produce a secondary emf, the frequency of which is determined by the speed of the rotor. By driving the rotor with a synchronous motor having a revolving armature connected in parallel with the secondary of the induction machine and provided with a commutator to furnish the excitation, there is had the machine invented by Le Blanc and Arnold.

The Le Blanc-Arnold method requires two entirely separate machines. The author, in collaboration with M. Boucherot, developed a method by which two electrically separate machines utilize the same magnetic circuit; that is, one rotor and one stator serve for two separate electric circuits which may be designed to deliver different frequencies. In use as a frequency converter one stator winding is connected to the primary circuit of one frequency, while the other stator winding is connected to the secondary circuit, which has a different frequency. The rotor may be wound for direct-current excitation, in which case the machine is synchronous and may be used to regulate the power factor of the line, or in special cases the rotor may be of the squirrel-cage type, thus rendering the machine asynchronous.

The second group covers the transformation of variable frequencies to a constant frequency. For instance, the secondary current of a variable speed induction motor, if transformed to the proper frequency, may be returned to the line instead of wasted in rheostats. The Scherbius polyphase commutating machine connected to the secondary of a variable-speed induction motor and coupled to an asynchronous generator may be used to accomplish this purpose. The machine of the author and M. Boucherot is also well adapted to this kind of a transformation.

The third group comprises transformations from constant to variable frequency, such as might be utilized in controlling the speed of an induction motor for traction purposes. This might be accomplished by driving a machine having a direct-current winding connected to the line through slip rings and to the induction motor through a commutator which delivers a frequency variable with the speed and an emf variable with the position of the brushes. No practical work has been done in this line.

The fourth group consists of transformations of relatively small amounts of energy from normal to relatively high frequencies such as are used in wireless-telegraph work. In this connection several static converters are described.

ELECTROMAGNETIC PHENOMENA RESULTING FROM SHORT-CIRCUIT OF AN ALTERNATOR.

M. P. Boucherot gave a succinct but comprehensive theoretical treatment of short-circuit phenomena in alternators. In the body of the paper he handled the subject from the physical standpoint and with very little mathematics, the rigorous mathematical development of the equations being given in an appendix. In the first section of the paper the author defined the various inductance coefficients which must be dealt with in studying the phenomena and established the relations between them. He then took up the polyphase short-circuit first developed equations for estimating the currents in the exciting and in the armature windings and the emf generated in the exciting or field winding. These equations have been checked by oscillographic tests.

In discussing the remedies the author pointed out that it is as desirable to increase the self-inductance of the field winding as it is that of the armature winding. However, when external inductance is used it should be confined entirely to the main circuit, because external inductance in the excitation circuit will require extra emf to overcome the ohmic drop in the reactor winding, and therefore in event of a short-circuit, relatively very large emfs will be generated in this circuit and may easily puncture the insulation. The use of reactors in the main leads does not involve similar danger, but it does require a considerable quadrature emf, which may call for an increase of from 15 to 30 per-cent above normal.

The effects of short-circuit in one phase and of short-circuit within the windings of the generator itself were next taken up. The most important phenomena in these special cases are the high emfs generated in the windings of the alternator. For example, in the case of a short-circuit in one phase, the maximum emf generated in the other phases may attain from ten to twenty times the normal value provided the iron is not saturated and that dampers are not used. Attention is also called to the fact that an internal short-circuit may subject the windings of the field circuit to emfs in the thousands of volts even when no appreciable external current is produced.

M. Boucherot's paper was discussed by Messrs. Feldmann, Brunswick, Thompson, Sarli and Holleux.

COMMUTATOR MOTOR FOR ROLLING MILLS.

M. R. Legouëz reviewed some of Latour's work on commutator motors, dealing especially with those that employ what is known as squirrel-cage commutation. The author gave a general definition of this type of machine and described several of these motors that have been built and put into successful operation. He proposed to use a compound Latour motor in connection with a flywheel for driving rolling mills. The compound motor described is a series alternating-current polyphase commutator motor with each pair of adjacent brushes shunted by a circuit containing a fixed emf and an adjustable impedance. When the impedance is zero the motor has pure shunt characteristics, and when it is infinite—that is, when the circuit is open—the motor has series characteristics. The fixed emf can be produced by a polyphase transformer, which should preferably be provided with a rotor and stator to permit regulation of the phase. The impedance is an inductive resistance arranged to permit regulation.

This system gives a total range of speed adjustment of about 15 per cent above and below normal at full load. It also gives a good efficiency and power-factor at all operating speeds. As little energy is handled by the shunt circuits and therefore the auxiliary devices are relatively small, the losses are quite insignificant as compared with the rheostatic losses in an ordinary induction motor-flywheel outfit provided with automatically variable resistors in the secondary.

The operation of the set is as follows: When the mill begins work the motor, having a shunt characteristic, develops its full power without an appreciable drop in speed; but when the power reaches a predetermined limit the impedance is automatically increased, which allows the motor to slow down, thus permitting the flywheel to do part of the work. As soon as the load falls off the impedance is cut out and the speed rises again, storing energy in the flywheel, which is now ready for another cycle of operation.

The paper was discussed by M. Sarli.

VARIABLE SPEED THREE-PHASE MOTORS.

The problem of economically regulating the speed of three-phase motors with special reference to rolling-mill operation was dealt with in a paper by Mr. C. Sarli.

After briefly referring to the Görges three-phase commutator motor the author described the Winter-Eichberg system of regulating the speed of a three-phase commutator motor by impressing an adjustable emf across the brushes. He next described briefly the series motor and its mode of speed regulation, and then he took up the double commutator motor of Brown-Boveri, which is in reality a combination of two Déry single-phase commutator motors. In concluding the discussion of the commutator motors he mentioned the methods of compensating the power-factor in the first two systems.

In the second part of the paper the author describes three cascade systems that have recently come into practical use. These systems all utilize energy from the main motor in a second and variable speed machine which returns it either to the shaft of the main motor as mechanical energy or to the line as electrical energy. Three methods are distinguished accordingly as (1) the second machine is a commutator motor coupled directly to the main motor; (2) the second machine is a direct-current motor to which the energy of slip is transferred by means of a converter; (3) the second machine is a commutator motor coupled to an asynchronous generator that feeds the slip energy back into the line.

In conclusion the author compared the various systems, showing that the commutator motors are used for low and medium powers, while for large outputs such as are required in rolling mills the cascade arrangements are better adapted. He then gives performance data and characteristics of some actual installations and refers to the use of heavy flywheels with such cascade groups.

The paper was discussed by Messrs. Legouëz, Palestrino and Finzi.

Regulation of Public Utilities.

At the annual convention of the League of American Municipalities held in Atlanta, Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, Chicago, delivered on Oct. 5 a clear-cut address entitled "Regulation of Public Utilities." Mr. Huey explained the dignity of conducting public-utility operations and said that there were probably 20,000 executives engaged in the operation of privately owned utility corporations in the United States. A number of people have referred to this body of men collectively as "corporation robbers." The speaker remarked that the gentlemen referred to like this term about as well, probably, as his hearers enjoy the phrase "a bunch of cheap politicians." Many public-utility operators believe themselves to be honest men trying to conduct a legitimate business in a decent and progressive way.

Public utilities in the United States have been developed, financed and made useful almost entirely by private initiative and private capital. Much has gone into this development besides money. The best years, the best energies, the most earnest thought of many men have been devoted to this development, together with shattered hopes, broken hearts and wrecked fortunes. There is a human side as well as a so-called "heartless-corporation" side to all of this endeavor.

The privately owned utilities of the country have a reasonable right to fair treatment based upon calm, intelligent study of the facts in each case. Operators of utilities have induced thousands of persons to place their capital in this service. "In our consciences," said Mr. Huey, "the integrity of this capital is synonymous with our honor, and we will defend it to the last extremity of lawful effort."

But there is no good reason why public officials and public-utility corporations should not work together in harmony, intelligence and for the common good. Public utilities are most efficiently and economically conducted as monopolies, but nevertheless no monopoly, however beneficent, should be permitted to exist without legal safeguards to protect the public. The speaker then went on to comment on the establishment of state public-service commissions and showed that on the part of the utilities there has been during the last few years a much keener realization of obligations due the public and customer than was formerly the case.

Private ownership of utilities means the employment of ability and capital at a wage, and if this wage is above the average of interest rates the service company is stimulated just as much as good wages stimulate the employee. This theory was recognized recently by the public-service commission in Wisconsin in permitting a utility organization to derive an annual profit of 12 per cent as a reward for excellence of service.

Comparatively few realize that there is intense competition now waging among American communities. The city which lags behind in doing the things which are incumbent upon municipal governments loses in the contest for industries, population and commerce. There never was a time when greater necessity existed for employing public funds in the most useful ways that will bring the greatest and the quickest returns. Under these circumstances it is not good business judgment for cities to bond themselves to place capital in electric, gas, telephone and street-railway companies when private capital is already interested and is willing to do the work for reasonable compensation. The operation of water-works, however, is properly a municipal function, as the vital necessity transcends its cost.

To-day there are fourteen states with utility commissions possessing powers of regulation over organizations supplying electricity, gas, transportation, telephone and water service. Twenty-seven states have commissions exercising control of varied degree over one or more classes of utilities, steam railroads included. The speaker then went on to point out a few general principles which must obtain if regulation is to prove a permanent and beneficial feature of civic life.

It is a mistake to consider the lowering of rates as the principal object of utility regulation. The true function is to ascertain and maintain equitable relations. Fair rates must be based on all elements entering into the cost of service, including interest and depreciation on the value of the property.

While the profits or income of the promoter and operator are secondary to the interests of the public and the owners, nevertheless the service is important and should be liberally rewarded.

A public utility should be placed beyond the possibility of a strike, and some provision should be made to cover this requirement. This regulation should provide for strict neutrality in the conflict between unionism and non-unionism.

In conclusion, Mr. Huey heartily commended a suggestion originating with Mr. J. C. Michael, formerly corporation counsel for St. Paul, Minn., suggesting that an interchange of representatives among the various organizations of municipal officers and the various organizations of utility managers would be of mutual value. Speaking for the National Electric Light Association, of which Mr. Huey is second vice-president, the speaker extended an invitation to the League of American Municipalities to send as many delegates as it desired to the Seattle convention of next year. He assured his hearers that the N. E. L. A. would heartily welcome such representatives and extend to them every facility for hearing papers and discussions. Furthermore, the association would be glad if some representative of the league would accept a place on the program of papers.

President McCarter of New Jersey Public Service Corporation on Public Service Regulation.

Mr. Thomas N. McCarter, president of the Public Service Corporation of New Jersey, recently discussed at length before the Board of Public Utility Commissioners of New Jersey questions relating in general to state regulation and in detail to the electric and gas rates of the subsidiary companies of the corporation. Mr. McCarter was formerly strongly opposed to public utility legislation, but he has since stated publicly that he has come to regard such legislation, as Governor Wilson says it is regarded in Wisconsin, as a protection and not as a menace. Mr. McCarter offered, on behalf of the corporation, to make reduction in rates for gas and electric service.

Taking up the subject of rates, Mr. McCarter added that the policy had been to lower rates in all branches of the business as rapidly as was possible, and in addition thereto, so far as its gas and electric business is concerned, to establish an absolute uniformity of rate for its commercial business, and this is now true in both branches of its business throughout the broad territory served, except that in two of the divisions the gas rate is $1 flat, whereas in the other four the rate is $1.10 with 10 cents a thousand discount for payment within a certain number of days. Aside from this, absolute uniformity exists. After years of consideration of the matter Mr. McCarter is satisfied that this plan of uniformity is of great advantage to the people of the State. Technically it may be open to some objection, but it has been of great assistance in the development of the smaller suburban places whose prosperity is so interwoven with that of the larger cities. The rates put into effect have only been possible by the centralizing of stations and long-distance distribution. This policy has now been the settled practice for so long that to attempt a radical departure from it would cause great confusion and dis-

satisfaction. The policy in this respect has been wise and should be continued, even though in its technical and theoretical aspects it may in some instances militate against the people of the larger cities to the benefit of the people in the large number of smaller municipalities.

The next question which presented itself was whether the actual capitalization of the Public Service Corporation was that which the board must recognize in the proceeding. Mr. McCarter insisted that it was. All these underlying companies, both gas and electric, upon which obligations of rental or otherwise have been assumed by the gas or electric company were, with only one substantial exception, results of mergers or consolidations expressly authorized by and made in compliance with the so-called merger or consolidation act of New Jersey. The stocks of the old companies were thus by direct authority converted into stocks and bonds of the new company, the practice generally followed being to provide sufficient bonds in the new consolidated company to take up the underlying bonds at maturity or before of the constituent companies, as well as to provide a quota of bonds for future financial needs. Thus, in effect and in law, the contracting companies to the various consolidation agreements fixed the value of their respective properties in the new capitalization, and provided as well for future improvements. In nearly all these cases the bonds retained for future improvements have long since been sold for value and the money used in betterments. In addition thereto, there has been spent upon these properties the respective investment of the gas and electric companies. These values, thus long ago fixed, are in point of law at this late day immune from attack by the rate-making power or otherwise, and said values thus fixed must now be taken to have been the value of the properties, physical and franchise, tangible and intangible, entering into the respective agreements of merger and consolidation, and the State is now estopped from attacking this capitalization. This legal proposition is based on the decision of the Supreme Court of the United States in the New York Consolidated Gas case. Precisely a similar state of affairs exists in New Jersey. The stocks of the underlying companies have been issued from twelve to twenty years. They have become scattered far and wide and, as in New York, have been traded in freely and widely on the faith of their legality. The State through its rate-making power cannot be now heard to attack it. Mr. McCarter regards this matter as settled for all time by the decision in the leading case quoted. However, if the conclusion that as a matter of law the validity of these securities *cannot* now be questioned is not controlling, then he insists, with equal vigor, that they *should not* be questioned by the board in the exercise of its discretion. The proposition of the radical is to ignore these existing securities and the covenants and obligations in reference thereto, and to make a fresh reproduction valuation of the property actually engaged in the gas and electric business, as the case may be, and then to fix an annual return which will be permitted upon that value thus ascertained.

Assuming for purposes of argument that the value, as fixed by the radical, will be much less than the existing capitalization, and that the board should allow a reduced rate of return upon that valuation, the blow would fall, in the first instance, upon those who have since put in large sums of money, and all—including the radicals—agree that the investment of money in these enterprises should be encouraged, and those who make it should receive a fair return on their investment. Secondly, the blow would fall upon those who over a long period of years have invested, in good faith, in these various underlying stocks; but the end would not be here. Many of the largest corporations, of a fiduciary or benevolent character, have, in good faith, invested large sums in these securities, or made loans upon the same as collateral. Mr. McCarter declared that there is not a bank or trust company chartered by the State—except savings banks—that would not be seriously affected by any such unfortunate situation. In short, a state of financial panic would ensue.

Continuing, Mr. McCarter directed attention to the impracticability of making a complete physical valuation of the gas and electric properties within any reasonable time; to the uselessness of any such appraisement when completed, and therefore to the advisability of arriving at some equitable solution of this problem quickly.

The complications that would exist in valuing gas and electric properties located in some 193 municipalities, large and small, must be apparent. Assuming that the value as ascertained is less than the capitalized value, the knowledge acquired would be purely academic unless made the basis of action that would lead to financial ruin. There is another aspect of the matter. Having arrived at such a fair valuation of the property, gas and electric, devoted to the public use as would stand the test of review by the courts, the next duty of the board would be to determine the fair rate of return to be allowed thereon. Mr. McCarter contended that not less than 8 per cent on such valuation is just and reasonable. That was the deliberate judgment of the Wisconsin commission in the Madison case, and that, after years of reflection, is his judgment as to the minimum amount to be allowed on a well-established property, if it is to meet the requirements for betterments and extensions that will be put upon it by an increased public demand.

The proposition for decreases in rates made by Mr. McCarter is as follows:

That a schedule of rates be fixed by the board, effective for five years from Jan. 1, 1912, on a basis that will recognize the obligations of the gas and electric companies as to their respective underlying securities, and will enable the gas and electric companies to pay annually a dividend of 8 per cent on their actual capital as it will exist from year to year, over the five-year period, after deducting proper reserves for maintenance, and after further providing a moderate fund for that portion of capital expenditure which business prudence demands should not be capitalized.

Based on a careful estimate of the prospective business of both companies for the next five years, the proposition contemplates, in the case of the gas company, the putting into operation of a uniform flat rate of $1 as of Jan. 1, 1912, and on Jan. 1, 1914, the reduction of this base rate to 95 cents and on Jan. 1, 1916, the further reduction of this base rate to 90 cents. In the case of the electric company it contemplates as of Jan. 1, 1912, the adoption of the same schedule of discounts from the base rate put into effect by the New York Edison Company. The present Public Service rate steps down 1 cent for every 500 kw-hours of monthly consumption for the first five steps; the New York rate steps down 1 cent for every 250 kw-hours of monthly consumption for the first four steps. In the fourth year of the period, or on Jan. 1, 1915, the base rate is further reduced from 10 cents to 9 cents, thus combining the first two steps of the existing schedule.

There will be at the end of five years, if the prognostications as to business are reasonably accurate, a surplus over the 8 per cent dividend and reserves in the electric company of approximately $1,650,000, or an average of $330,000 a year—a sum quite inadequately. In the judgement of Mr. McCarter the electric rate should not be reduced at all. The additional earnings which would result therefrom should be used as rapidly as possible to bury wires, relieving so much the more rapidly the congested sections of the cities from overhead electrical constructions for the transmission of energy for commercial purposes.

The subject of a proper reserve for purposes of depreciation, permanent renewals, obsolescence, unforeseen catastrophes and what-not is one that has been forcing itself to the front and engaging the attention of all thoughtful men conversant with public utilities. The fact is it has become a practical necessity for companies to consider the

subject. All intelligent bankers now require it as a prerequisite to the purchase of securities. The corporation has for years given this subject a most thorough consideration, and at the time of the first large sale of the general mortgage bonds to bankers the subject was thoroughly considered by the bankers, their experts, Messrs. Stone & Webster, and by officials of the corporation, and an agreement was reached providing for the gradual accumulation of such a reserve, starting in a small way, but with as large an amount as the company at that time was able to bear and still do its duty to the public and to its stockholders, but increasing annually. For the year 1912 the sum to be placed in the reserve is $600,000, for 1913 it is $800,000, for 1914 it is $1,000,000, and it increases from then on, proportionately with the earnings, up to $1,500,000. In addition to this, commencing in 1913, the corporation is obliged to establish a sinking fund, amounting to $209,500 annually, for the retirement of general-mortgage bonds.

Mr. McCarter would feel justified in appealing to the board for protection by raising rates against any action by any other arm of the State government, the effect of which was to make impossible the results herein outlined, such as, for example, any new form of taxation largely in excess of that now in force.

Estimates of the earnings of the Public Service Electric Company for the next five years show gross earnings of $7,649,873 in 1912. And the increases are figured at 12 per cent in 1912, 11 per cent in 1913 and 10 per cent annually for the rest of the period. The operating ratio is computed at 46 per cent. The decreases expected from reduction are deducted from the net earnings in the estimate.

The corporation is now paying dividends at the rate of 6 per cent per annum. Mr. McCarter added that it has been the frank hope of the management that the earnings for 1912 would justify placing the corporation upon a 7 per cent basis, and in 1913 upon an 8 per cent basis, there to remain at least for the early future. Using the results shown as a basis, it is apparent that if this plan be adopted, these expectations will not be realized, and all that the corporation can hope to do is to continue its 6 per cent dividend in 1912 and the first half of 1913, and thereafter during the period probably pay a 7 per cent dividend, accumulating, in addition thereto, a surplus that in the later years might justify an 8 per cent dividend.

In conclusion, Mr. McCarter stated that a great opportunity is here presented for a just and honorable settlement of what otherwise might turn out to be the most dangerous and perplexing problem that has been injected into the public affairs of New Jersey since the days of the civil war. The corporation has still left available for improvement $20,000,000 of bonds. Its supply of bonds will then be exhausted. Future funds for the development of these great properties can come only from three sources—the expenditure of the reserve for construction purposes, the investment of further surplus earnings, and additional issues of stock. As the municipalities grow larger and larger the amount of money annually needed for improvements will increase. It has averaged over $6,000,000 a year since the formation of the corporation.

Discussing the claim that the corporation is active in politics, Mr. McCarter added that just as long as approximately 10 per cent of the bills introduced into the Legislature at Trenton directly affect the business of the corporation just so long will the corporation not only be justified but required to defend itself from such attacks by any legitimate means within its power. Two-thirds of the bills have no excuse for their existence other than an attempt on the part of the introducer to pander to popular clamor or to blackmail the corporation. The board could perform no better work than helping to take the corporation out of politics, and in no way could that work be better started than by a permanent adjustment of the matters under discussion.

The Kansas Workmen's Compensation Act.

The new workmen's compensation act recently passed by the Kansas Legislature represents almost a complete reversal of the usual legal principles under which an injured employee may seek redress by civil suit for damages. The new law recognizes only the paramount fact that the employee injured has lost a part or all of his earning power as a sacrifice to the industry in which he is engaged, and then proceeds to fix definite amounts for damages due him or his dependents, based on the extent of his injury and his former earning power. The relations defined are so simple as to be calculable even without pencil and paper, and under these definite provisions the employee is assured the full amount of the damages paid, without the usual heavy legal and court fees which so often absorb the major part of the amount deserved by the injured man.

In explaining the provisions of the act before the Kansas Electrical Association at Independence, Sept. 21, Mr. Charles Kerr, representative from the Sixth State District, and, with Mr. H. E. Gauss, of the State Senate, joint author of the bill, presented figures to show that of $255,000 expended on workmen's damage suits during a recent year in the Kansas courts only 16 per cent actually reached the injured men on whose behalf the cases were brought, the rest going for insurance, legal expenses, court fees, etc. Data taken from 11,000 accident cases, said Mr. Kerr, also show that the injured workmen were actually recompensed by only 20 per cent of the losses they sustained through their injuries. The new law is designed to relieve both employer and employee of the heavy tolls thus charged for this inequitable distribution of benefits from injury suits, in which only the smallest part of the money spent by the employers really reaches the employees.

The provisions of the new law apply specifically, among other subjects, to all "electrical work" connected with the construction, installation, operation, alteration, removal or repair of wires, cables, switchboards or apparatus used for the transmission of electrical energy, and to work in electric-lighting plants, electric-power plants, water-power plants, steam-heating plants, artificial-gas plants and street and interurban electric railways.

Where the workman dies as a result of his injuries, leaving others who are wholly dependent on his earnings, the latter are by the new statute entitled to an amount three times his annual rate of average wages, but not less than $1200 or more than $3600. If these dependents reside abroad the award is limited to $750. In case the dependents did not rely wholly for support upon the man killed they are entitled to receive an amount as above proportional to their sustained loss. If the decedent has no dependents the employer is required to pay only a reasonable amount for medical attendance and burial, not exceeding $100.

Where the injury results in total incapacity for work the injured man is entitled to payment—during the time of his incapacity after the second week, but for a period not exceeding ten years in all—of an amount equal to 50 per cent of his daily earnings, but not more than $2.50 or less than $1 per day. In case of partial disability the allowance ranges from 50 per cent down to 25 per cent of the former wages. In the case of persons under 21 years of age receiving less than $10 weekly the limiting compensation prescribed is 75 per cent of the former wages.

The above rates of workmen's compensation apply only when the injury received occurred in the regular course of work of the employee and are rendered void, of course, if it is shown that he deliberately intended the injury, willfully failed to use guards or precautions provided by the employer, or was intoxicated at the time of the accident. Contingent fees of attorneys for services and proceedings under the compensation act must be in every case subject to the approval of the court having jurisdic-

tion. The insertion of this clause has the purpose of preventing any extortionate rates of contingent fees under the act.

The general provisions of the Kansas law apply only to employers having five or more employees in their service and who have elected before the accident to come within the provisions of the law. Such election on the employer's part to come within the terms of the new law is binding upon him for the period of a year, and also thereafter without further act on his part, unless he has filed sixty-day notice withdrawing his election. All employees entitled to come within the protection of the act are presumed to have done so without specific election on their part. They may, however, withdraw from the provisions of the act if they desire, after giving notice to their employer. Where such withdrawal is made, however, as a condition of employment the contract between employer and workman becomes void. In case an employer who has elected not to come under the provisions of the law is afterward sued by an injured workman his customary legal defenses of assumed risk, fellow-servant act and contributory negligence are removed by the terms of the new statute.

California Public Utility Constitutional Amendments.

As a result of a special election Oct. 10, held for the purpose of voting upon twenty-three amendments to the State constitution, two amendments relating to public utilities were adopted. One of these authorizes the Legislature to enlarge the powers of the State Railroad Commission and extend its jurisdiction to include all public service corporations, while the other extends the power of municipalities over building utilities.

The first mentioned declares that every private corporation and every individual or association of individuals owning or operating any commercial railroad, interurban railroad, street railway, canal, pipe line, plant or any equipment relating to such, for the transportation of passengers or freight, or for the transmission of telephone or telegraph messages, or for the production, generation, transmission, delivery or furnishing of heat, light, water or power, and every common carrier, is a public utility, subject to control and regulation by the railroad commission. The commission shall have the power to supervise and regulate all public utilities and to fix the rates to be charged for the commodities furnished or for services rendered. The right of the Legislature to confer powers upon the Railroad Commission respecting public utilities is declared to be plenary and to be unlimited by any provisions of the constitution.

All powers now vested in boards of supervisors or municipal councils or other governing bodies of the counties, cities and towns, or in any commission created by law and existing at this time, shall cease so far as such powers shall conflict with those conferred upon the State Railroad Commission; provided, however, that at an election to be held pursuant to laws a majority of the qualified electors may vote to retain such powers, and until such election the said powers shall continue unimpaired. If the vote should not prove favorable to retention the powers become vested in the railroad commission, or a vote may be taken expressly for the purpose of surrendering such powers to the railroad commission, with provision that the power may be reinvested by a vote of the counties, cities or towns.

By the second constitutional amendment any municipal corporation may establish and operate public works for supplying its inhabitants with light, water, power, heat, transportation, telephone service or other means of communication. Such works may be acquired by original construction or by the purchase of existing works, including franchises. Persons or corporations may establish and operate works under the regulations prescribed by the municipality on condition that the municipal government shall have the right to regulate the charges thereof. A municipal corporation may furnish service to inhabitants outside its boundaries; provided that it shall not furnish any service to the inhabitants of any other municipality owning or operating similar works without the consent of such municipality expressed by ordinance.

By another constitutional amendment the Railroad Commission is increased from three to five members, to be appointed by the Governor, instead of being elective, as heretofore. The term is extended from four to six years. Members of the commission may be removed from office for just cause by a two-thirds vote of the Legislature.

By a Senate constitutional amendment the Legislature may create and enforce a liability on the part of all employers to compensate their employees for any injury incurred in the course of their employment, irrespective of the fault of either party. Settlement of any dispute under this legislation may be by arbitration or by an industrial accident board, by the courts, or by all of these agencies, at the discretion of the Legislature, anything in the constitution to the contrary notwithstanding.

New York Commission News.

The Public Service Commission, Second District, has received a complaint from Charles Berger, of New York City, a subscriber of the New York Telephone Company, directed against that company, asking that the commission make an order directing and requiring the telephone company to adjust the rates charged for local messages in excess of those included in the yearly rate on the basis of allowing any unused messages to apply as a credit to any succeeding year of such contract. He states that during the year 1910 he used about 650 messages, during the year 1909 about 400 messages and during the year 1908 about 225 messages, while up to Oct. 1 this year he has used about 825 messages, for which the company is charging him $4 per month plus 5 cents for each local message. He alleges that it is unreasonable for the company to charge him for excess local calls above the 600 for this year, when during the years 1908 and 1909 he used only about half of the 600 calls allowed under his contract each year, and also that it is unreasonable to charge him $4 per month in addition to the 5 cents for each message that he has been charged with since the 600 local messages were used. The telephone company has been required to answer the complaint within twenty days.

CURRENT NEWS AND NOTES.

LOS ANGELES A. I. E. E. SECTION.—The Los Angeles Section of the American Institute of Electrical Engineers opened the season of 1911-12 with an informal dinner on Oct. 17, at which Dr. J. A. B. Scherer, president of Throop Polytechnic Institute, Pasadena, delivered an address on "Technical Education from the Practical Standpoint."

* * *

DEEP-WATERWAYS CONVENTION.—The sixth annual convention of the Lakes-to-the-Gulf Deep-Waterways Association was held in Chicago on Oct. 12, 13 and 14. The association reaffirmed its demand for a 14-ft. waterway in the Illinois River and Mississippi River, connecting Lake Michigan and the Gulf of Mexico. Politics was tabooed, and there was no action on water-power possibilities, which, in Illinois, are affected by politics.

Nobel Prize for Edison.—It is reported that the Nobel prize for physics of about $40,000 will this year be awarded to Mr. Thomas A. Edison. The prize in previous years has gone to Röntgen, Lorenz and Zeeman, the Curies and Becquerel, Rayleigh, Lenard, J. J. Thomson, Michelson, Lippman, Marconi and Braun, and Van der Waals.

* * *

New York Companies' Section, N. E. L. A.—The first meeting of the season of the New York Companies' Section of the N. E. L. A. was held in the Edison auditorium, Oct. 16. The meeting was given over to discussion on contest papers dealing with the technical, accounting and commercial sides of the recent N. E. L. A. convention in New York.

* * *

Annual Banquet of Commonwealth Edison Section, N. E. L. A.—The annual banquet of the Commonwealth Edison Company Section of the National Electric Light Association will be held at the Sherman House, Chicago, on the evening of Nov. 1. At that time announcement will be made of the result of the spirited election for officers of the section that has been in progress.

* * *

Commercial Vehicles in Denver.—According to the *Denver Municipal Facts*, Denver possesses more power trucks per capita than several other leading cities where such figures are available. Denver has one truck to every 1800 inhabitants, Philadelphia one to 3000, Cleveland one to 5000, Seattle one to 3000, Los Angeles one to 4400, San Francisco one to 5200 and Oakland one to 2500.

* * *

Valparaiso (Ind.) Company to Purchase Electricity at Wholesale.—The Valparaiso Lighting Company, of Valparaiso, Ind., belonging to the Kelsey-Brewer Syndicate, of Grand Rapids, Mich., will shut down its plant and buy electrical energy at wholesale from the Northern Indiana Gas & Electric Company, which operates throughout an extensive area along the southern shore of Lake Michigan.

* * *

Comparison of Voltmeters and Ammeters.—The Bureau of Standards, Washington, has issued as reprint No. 163 a paper which recently appeared in the *Bulletin* of the bureau, giving a comparison of American direct-current switchboard voltmeters and ammeters. The comparison is under eight heads, namely, accuracy of calibration, effect of stray fields, damping, mechanical balance of moving parts, resistance and power consumption, zero shift, insulators resistance, temperature coefficient and ruggedness of moving system. One section of the paper deals with details of construction.

* * *

Explosion of Blow-off Tank in Power House.—A blow-off tank used for the blowing out of boilers exploded in the power house of the Metropolitan West Side Elevated Railway Company on Throop Street, Chicago, at 12:40 a. m. on Oct. 9. Three of the boilers had been blown out and the power-house attendants were blowing out a fourth when the accident occurred. The blow-out tank was made of iron and had a connection to the sewer and also a vent to relieve the pressure. It was ruptured by the explosion, which also blew down a portion of the side wall of that portion of the building and a section of the tile roof which was about it. The damage was not great, being estimated at $2,000. None of the boilers, engines, generators or other machinery was injured. There was some damage to the adjacent elevated-railway structure, but traffic was not interrupted seriously, for, fortunately, the trouble occurred at the time when travel is light. The cause of the accident is not known, as after the explosion the vent was tested and found unobstructed. The power house in question supplies about two-thirds of the energy required for the system, the remainder being purchased from the Commonwealth Edison Company.

* * *

Probably No Chicago Electrical Show Next Year.—It is reported that there may be no electrical show in Chicago next year. Beginning in 1906 the Electrical Trades Exposition Company has given an electrical show every January in the Coliseum. These exhibitions have been largely attended and very interesting, with spectacular lighting effects. As the number of electrical shows throughout the country has increased, however, electrical manufacturers and dealers have protested against the increasing expense. At the 1911 Chicago show a profit-sharing plan was announced, but it appears not to have been successful, and in consequence of the disaffection of many former exhibitors it is probable that the 1912 show will be omitted. There has been no official announcement on the subject, however.

* * *

Northern Indiana Gas & Electric Company's Extension.—The Northern Indiana Gas & Electric Company is planning to erect a new substation at the corner of Sheffield Avenue and Hanover Street, in Hammond, Ind. The company has arranged to purchase the surplus energy of the Chicago, Lake Shore & South Bend Railway Company, operating between Chicago and South Bend, Ind., which has a large generating station at Michigan City, Ind., 35 miles east of Hammond. The new substation is designed to utilize this supply of energy. Electricity will be received at 33,000 volts from an overhead transmission line and reduced to 6600 volts in the substation. While the railway is operated single-phase, the electricity sold to the central-station company will be three-phase, 60-cycle. Three 750-kw transformers will be installed, and the substation will also be equipped with high-tension switching apparatus and tub-regulating transformers. From Hammond the Northern Indiana Gas & Electric Company transmits electricity for general commercial purposes to East Chicago, Indiana Harbor and Whiting, as well as in the city of Hammond itself. The area covered is devoted largely to manufacturing purposes, and the industries gathered here are expanding rapidly both in number and extent. Mr. W. D. Ray is general manager of the company.

* * *

Philadelphia Electric Company Section.—The active work of the Philadelphia Electric Company Section for the season was inaugurated on Sept. 25, with the meeting of the Commercial Department Branch. Mr. R. L. Lloyd read a paper on "Refrigeration from the Commercial Standpoint." On Oct. 5 the Accounting Department Branch gave close attention to a paper entitled "The Accounting System of the Philadelphia Electric Company," by Mr. Frank A. Birch. The Meter Department Branch held a meeting Oct. 6, when a paper on Fort Wayne and Westinghouse meters was presented by Mr. W. H. Donley. The formation of an Engineering Department Branch is anticipated, with others to follow. The October meeting of the Section was held Oct. 13. All branches, as well as members not yet identified with any departmental branch, attended. The membership committee reported a total membership of 533. Chairman Sproule made the announcement that Past-president Wm. C. L. Eglin had donated a handsome gold watch to be awarded as a prize for the best paper presented at any department branch meeting of the section by a Class "B" member of the N. E. L. A. President John F. Gilchrist of the N. E. L. A., Mr. R. S. Orr, president of the Pennsylvania Electric Association; Mr. Wm. C. L. Eglin and Mr. A. R. Granger addressed the meeting.

Exposition of New Inventions.—What is said to have been the "first international exposition of new inventions" was held at the Coliseum, St. Louis, during the week ended Sept. 16. Several electrical devices were shown.

* * *

Wireless Spans the Pacific.—For the first time in the history of wireless transmission communication was established Oct. 5 between the San Francisco operator at Hill Crest and the Hokushu station, Japan, 6000 miles distant. Hokushu is the most northern wireless station of Japan.

* * *

Bulgarian International Exposition.—An international exposition will be held in Sofia, Bulgaria, next summer during the months of June, July and August. Full particulars concerning the exposition may be obtained upon application to the organization committee, 5 Alexander Place, Sofia.

* * *

Electric Signs in Paris.—The prefect of the Department of the Seine has decided to put a stop to the constant increase in illuminated street signs, which are transforming the principal boulevards of Paris into thoroughfares, "resembling streets in an ordinary inartistic American city." Henceforth a heavy fine will be imposed on all signs of this description.

* * *

Modern Pole Lines.—The consumption of poles for telephone, telegraph, steam and electric railway and light and power companies during 1910 fell little short of 4,000,000 poles. Of the 3,870,694 poles purchased during 1910, 2,831,810, or 73.2 per cent, were reported by telephone and telegraph companies; 733,092, or 18.9 per cent, by electric railroad, light and power companies, and 305,792, or 7.9 per cent, by steam railroad companies. In 1909 the total purchases were 3,737,740 poles compared with 3,249,154 in 1908 and 3,283,268 in 1907. Cedar wood supplied the largest proportion, having contributed 62.8 per cent for 1910, against 65.3 per cent in 1909 and 64.2 per cent in 1907. In 1910 21 per cent of the total purchases reported were subjected to some sort of preservative treatment to increase their durability.

* * *

Chicago Subway Project.—The local transportation committee of the City Council of Chicago does not acquiesce in the Mayor's proposal that the proposed passenger subway shall be built by a subway commission reporting to the Mayor. The committee has amended the ordinance offered by the Mayor in such a manner that, if the amended ordinance is adopted, the members of the subway commission shall be appointed "by and with the approval and confirmation" of the City Council and shall report their plans and specifications to the City Council rather than to the Mayor. The Mayor says that the opposition of some of the aldermen to his plan is only a cloak for opposition to a subway of any description. A referendum vote on the question of whether Chicago shall build a downtown passenger subway has been suggested.

* * *

Electrical Engineering at University of Minnesota.—A five-year course in electrical engineering has now been in operation for three years at the University of Minnesota, and is giving good satisfaction. The work of all engineering students is uniform during the first year, but in the second year the civil engineering course begins differentiating by substituting geology and surveying for the shop work of the course in electrical and mechanical engineering. In the third year the electrical and mechanical courses begin to diverge, one taking up applied electricity and the other fuel analysis. After the successful completion of the first four years of work, the degree of bachelor of science in engineering is conferred. The work of the fifth year is more definitely specialized, leading to the degree of civil, electrical or mechanical engineer. A considerable number of students take only the more general work of the four years, and do not qualify as engineers.

* * *

Motor-Driven Block Signals.—Extensive applications of electricity to block signaling on the Harriman lines in the Far West have been utilized by the management as a means of stimulating passenger traffic through the display of full-sized working safety-signal equipments at many important stations and city ticket offices. The signal equipments are shown with glass fronts, behind which the motor-driving mechanism and control apparatus can be seen in full operation, and the standard movements and lantern colors are indicated during the day and at night correspondingly. In a typical home and distant-signal exhibit at Salt Lake City the company points out that in the calendar year 1910 the Union Pacific and Oregon Short Line railroads carried 49,491,000 passengers without fatal injury to any. The manner of working is outlined and the protection against collision, broken rails, misplaced switches and faulty clearance on sidings or switches is emphasized. The value of electricity in protecting train movements, as shown by these exhibits, is keenly appreciated by the public.

* * *

Convention of Railway Electrical Engineers.—The fourth annual convention of the Association of Railway Electrical Engineers will be held in Chicago at the La Salle Hotel from Nov. 7 to 10. There will be morning and afternoon sessions on each of the four days indicated. Among the papers to be presented are the following: *Insulation*, by Mr. K. R. Stranberg; *The Light for Safety*, by Mr. F. R. Fortune, and *Industrial Trucks for Railway Service*, by Mr. T. V. Buckwalter. There will be reports of committees on "Data and Information," "Car Ventilation," "Standards," "Improvements," "Shop Practice," "Specifications," and "Accounts and Reports." The entertainment features include a dance, a theater party and an automobile tour. Space has been provided for twenty-nine exhibits by manufacturers. The officers of the Association of Railway Electrical Engineers are: President, Mr. J. R. Sloan; vice-president, Mr. F. R. Frost; secretary-treasurer, Mr. J. Andreucetti. The exhibits and entertainment are in charge of the Railway Electrical Supply Manufacturers' Association, of which Mr. H. A. Moore is president and Mr. J. Scribner secretary.

* * *

New York Section, I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society held on Oct. 12 brief reviews and discussions were given of the papers presented at the Chicago convention by Messrs. A. J. Marshall, H. E. Ives, S. W. Ashe, G. H. Stickney, N. Macbeth, L. B. Marks, A. S. McAllister and E. L. Elliott. Abstracts of the papers and the discussion thereon at Chicago appeared in our issues dated Sept. 30 and Oct. 7. In commenting on the paper entitled "The Analysis of Performance and Cost Data in Illuminating Engineering," Mr. Macbeth claimed that it would be unwise to permit the representatives of manufacturers to submit papers containing performance and cost data relating to commercial types of lamps, because the data thus submitted would subsequently be published as having received the official indorsement of the Illuminating Engineering Society. In commenting on the paper entitled "The Effectiveness of Light as Influenced by Systems and Surroundings," Mr. Marks expressed the opinion that the observations recorded in the paper did not justify the conclusions drawn by the author relative to the advantages of the indirect over the direct system of lighting. Dr. Ives pointed out that the author failed to take account of the variables and constants in the problem so that his observations could not be classed as investigations. Moreover, the visual acuity method of determining the illumination with a printed page as the test object is subject to variation by different observers throughout a range of several hundred per cent.

Mexican Technical School.—The Mexican government will establish a school of electrical science and telegraphy in the Government Building in Calle de Chiquis, Mexico City. Correspondence instruction is to be maintained in connection with the school.

* * *

Central-Station Service in Europe.—The annual kw-hour output of the principal electric-lighting company in Paris is little more than twice that of Scranton, Pa., and Brussels, Belgium, with a population of 750,000, has an output about equal to that of Marion, Ind.

* * *

Rewiring of Colorado Capitol.—The Colorado Legislature has authorized the complete rewiring in conduit of the Colorado Capitol at Denver. This work will cost about $40,000. The $10,000 available this year is being placed in the rewiring of the basement and the attic, following the recommendation of Mr. W. J. Canada, electrical engineer of the Rocky Mountain Fire Underwriters' Association.

* * *

Institute of Operating Engineers.—The educational committee of the Institute of Operating Engineers is now working on the lesson papers to be used in the various studies by those who intend to follow the courses of the institute. The institute courses have recently been adopted in Armour and Lewis Institutes, of Chicago, and Y. M. C. A. classes in New York City, Buffalo and Denver.

* * *

Another Screw Standard.—The Society of Automobile Engineers has announced the details of a new screw standard devised by a committee of the society, which supplants a standard adopted in 1906 by the Association of Licensed Automobile Manufacturers. While screw standards are thus increasing in this country, the metric screw standard has finally supplanted all others on the continent of Europe.

* * *

Diesel Marine Engines.—The British Admiralty has placed an order for a Diesel engine of 6000 hp for a warship and another for a torpedo-boat destroyer, the latter to have a horse-power of 1000. An English firm of shipowners has ordered a Diesel marine engine for a 6000-ton vessel, and a Hamburg line freight vessel now under construction will have a Diesel marine engine. Two vessels of the German Woermann Line are powered with Diesel engines, which have been working satisfactorily for some time. This type of engine is also being applied to a new type of submarine vessels.

* * *

Electrolysis in Chicago.—The commissioner of public works of Chicago has notified the elevated and surface railways of Chicago to take measures to stop the leakage of electricity from their structures and rail returns, as it is asserted that electrolytic corrosion caused by such escaping current causes damage to the city's water mains and bridges. The complaint is based on a report by Mr. Ray Palmer, a consulting engineer retained by the city to make an investigation of the electrolysis problem, as related in an article in the *Electrical World* of Aug. 19, 1911, page 431, entitled "Electrolysis Situation in Chicago."

* * *

Electrical Equipment of Chicago & Northwestern Terminal.—G. Neiler, the engineer who designed the electrical and mechanical equipment of the new passenger terminal of the Chicago & Northwestern Railway in Chicago, read, in abstract, a comprehensive paper describing the installation before the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers on Sept. 27. This is the third of three long and profusely illustrated papers describing various engineering features of the terminal read before the Western Society within the last few weeks. The electrical and mechanical equipment, which cost about $1,500,000, is very elaborate and complete, containing many special applications of great interest. It was described in two articles published in the *Electrical World* of Aug. 19 and Aug. 26 last. Mr. Neiler made the interesting statement that the exhaust-steam turbo-generator (which supplements main generating units having non-condensing reciprocating engines) produces electrical energy at less than 0.1 cent per kw-hour. Messrs. G. T. Seely (who presided), A. Bement, F. J. Ravlin and F. F. Fowle took part in a brief discussion.

* * *

Privacy of Telegraphic Communication.—Mr. De Witt B. Lowe, a prominent broker, and four other men have been arrested in Salt Lake City on charges of stealing stock quotations and stock information from the private New York wires of E. F. Hutton & Company, brokers. The arrests were the result of a long search directed by Badger Brothers, local representatives of E. F. Hutton & Company, as to the source from which the Lowe brokerage company obtained information which supposedly only Badger Brothers should know. Expert wiremen in conjunction with Pinkerton detectives ascertained that it was caught by megaphone and vibrators from the sounders in Badger Brothers' office and then transmitted over private wires to San Francisco under supervision of Moss & Company, an independent brokerage firm of that place. As there were no actual electrical connections to the wires of E. F. Hutton & Company, the men could not be charged with wire tapping, but are held under bail on charges of reading and using information from telegraphic messages not addressed to them, this being punishable in Utah by from one to five years' imprisonment or a fine of $1,000. Representatives of all of the firms involved aver that widespread investigations will be held. Undoubtedly the result will be watched for with great interest by the telegraph and telephone companies.

* * *

Cincinnati Central-Station Tax Valuation.—The Ohio State Tax Commission granted another hearing to the Union Gas & Electric Company of Cincinnati on the final valuation of $15,000,000 placed on its property, at which Vice-president R. W. White made the argument that the company had been placed at a great disadvantage by the backward spirit in Cincinnati, which makes it almost impossible to sell gas and electrical energy at a profit. The conservative German element was blamed for a great part of this, and the assertion was made that the company sells only about half as much gas per meter as any other city in the county. The company has more adverse conditions to meet, he said, than any other company in the United States and perhaps in the world. It had been paying $140,000 a year as taxes, but the new valuation would require it to pay $190,000. Federal and state excise taxes will increase this materially. In addition the Public Service Commission is likely to require extensions where they are not profitable, and it is possible that the electrical plant will have to be abandoned and a new one built because of the impossibility of securing canal water for the condensers. Judge R. M. Ditty, chairman of the commission, stated that this body has nothing to do with the amount of money that is paid in taxes, as that lies wholly with the local tax officials, but that it is its duty to place the full valuation upon all public utility properties. He indicated that the valuation in this case is really too low if any mistake has been made. He also said that the commission has spent more time upon this company and given it a more careful investigation and consideration than any other one in the State. He promised, however, to hear further arguments and examine further data in order to satisfy both sides to the controversy.

A KANSAS NATURAL-GAS-DRIVEN STATION.

Electricity for Power Competes Successfully with Natural Gas in Independence, Kan.

Kansas-Built 500-hp Gas Engine.—Jacket Water-Cooling Tower.—Forty Electric Pleasure Vehicles in Town of 12,000 Inhabitants.

THE history of the application of gas engines to drive central-station lighting plants in the Southwest has hardly yet become one of uneventful satisfaction, and interest is still felt in stations of this kind operating on natural gas which have proved really thorough and unqualified successes after several years of operation. A successful small station of the kind is that of the Independence Electric Company, at Independence, Kan., a 775-kw plant which contains three different types of gas engines and includes several ideas of novelty in its arrangement of exhaust and cooling tower for the jacket and piston circulating water.

In other respects as well, besides its internal-combustion engine operation, is the Independence central-station situation of noteworthy interest among similar towns of 12,000 population. In spite of cheap natural gas a number of the local industries are operated from the lines of the electric company, whose connected load in motors is larger than its evening lighting peak. But perhaps most notable of all is the number of electric pleasure vehicles in use in Independence, where nearly forty cars provide a desirable off-peak charging load for the plant.

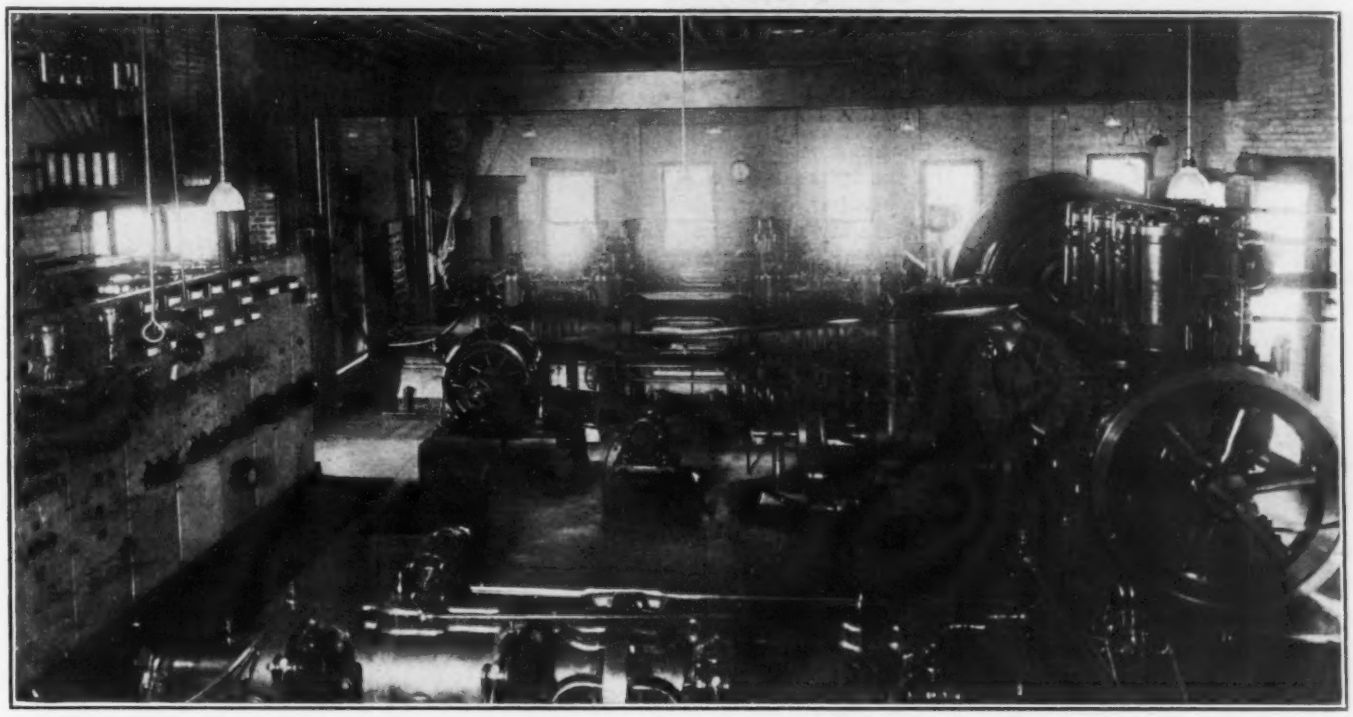


Fig. 1—Interior of Gas-Engine Station of Independence Electric Company, Independence, Kan.

GAS-ENGINE EQUIPMENT.

The gas-engine equipment of the Independence plant comprises a 500-kw horizontal, twin-tandem, double-acting Strait Monarch engine driving a 2300-volt, 60-cycle, three-phase alternator made by the Electric Machinery Company, of Minneapolis; a Snow twin-tandem, double-acting, horizontal engine driving a 200-kw General Electric alternator at 200 r.p.m., and a 100-hp Westinghouse vertical three-cylinder engine belted to a 75-kw General Electric alternator. The small Westinghouse engine is the original pioneer of the station, but is now reserved for auxiliary duty in case of breakdown of the other two units. The 200-kw Snow engine set is employed on Sunday, when the large engine is shut down for general overhauling and inspection. Under the present schedule of operation the 500-kw Strait engine, the principal unit of the station, is thus run continuously from 4 o'clock Sunday evening until 8 o'clock the following Sunday morning, and has been carrying out this program without interruption during the eighteen months it has been in service. Except for its periodical Sunday rests this engine has been shut down only five times, for a total of nine hours, during the period of its service.

The performance of the Independence plant has been watched with much interest by other Kansas plant operators, who feel a state pride in the fact that this large 500-kw engine was built on Kansas soil at Kansas City, Kan., and although it was the first gas engine which its designer, Mr. H. O. Hem, had ever built, it started up eagerly when first turned over in the Independence plant, and has been run without interruption since. As already noted, the unit is of the horizontal twin-tandem, double-acting type, with cylinders 16 in. by 30 in., and is direct-connected to drive its alternator and a 64,000-lb., 12-ft. flywheel at 150 r.p.m. The exciter is belt-driven.

ENGINE DETAILS.

Several unique features of design characterize this engine. The fuel mixture is separately supplied to each end of each cylinder, thus enabling any cylinder to be cut off if desired and insuring short passages between the throttles and cylinders, so that a governor action of the valves is at once effective in regulating the gas entering the cylinders. Lubricating oil is fed under pressure to the cylinders and exhaust valves, the lubricating ports being so positioned that the oil flows down both sides of the wearing surfaces. The speed of the engine is controlled by a high-speed centrifugal governor, which develops a controlling thrust of 500 lb. with 3 per cent variation in speed. This governor acts through a system of rods to control the mixing valves for each cylinder. These mixing valves are constructed with exposed spanner-wrench grips so that with the aid of an indicator stamped on the steel any valve can be set to any desired aperture without dismantling the valve or shutting down the engine. Each cylinder is also ignited on opposite sides to insure rapid and effective combustion of

the charge. The eight igniters are controlled from a timing commutator, with adjustable rocker arm, mounted on the half-speed lay-shaft. The ignition energy is taken from the exciter.

The lay-shafts are further unique in being each driven

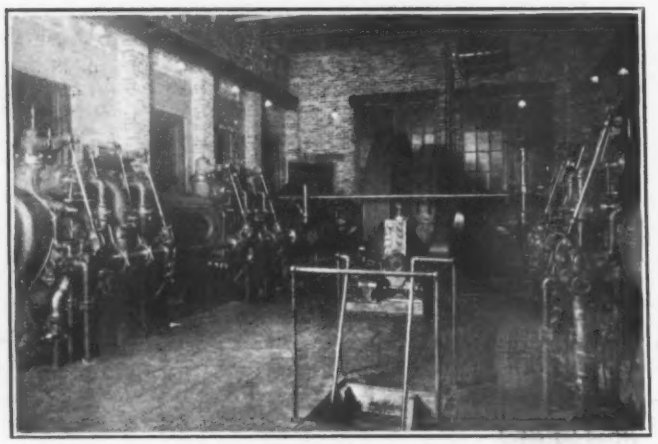


Fig. 2—500-kw Horizontal, Twin-Tandem, Double-Acting Gas-Engine Unit.

through two pairs of bevel gears and an intermediate shaft set at an angle of about 20 deg. with the lay-shafts themselves. By the arrangement of this peculiar drive, for which special gear teeth were required, the lay-shaft is not only dropped several inches below the engine-shaft center-line, but is also brought in much closer to cylinder casings, so that the shaft and its eccentrics are out of the way. As the lay-shaft is below the piston center-line and the guides have been cast with specially large openings it is possible to reach the bolts inside, as well as to remove the interior cylinder heads through these guide openings. The cylinders are also cast with split jackets so as to be easily accessible.

The manufacturers had assured the Independence Electric Company that even the exhaust valves might be removed and changed with the engine running without affecting its operation or load. Recently a spring broke in one of the valves, and although this did not require the dismantling of the valve, the entire exhaust-valve mechanism was removed and restored by four men working three hours, the engine meanwhile carrying its load unaffected. Before this experiment was tried it had been the intention to purchase a duplicate of the present unit for use in case of shut-down, but after finding that the exhaust valves might be thus replaced with the engine running the intended purchase of auxiliary equipment was confined to an extra exhaust valve. Ample circulation of water is permitted through the exhaust valves, so that even the paint remains unscorched on these valves after nearly two years' operation. The hand-valves controlling the various circulating-water lines are all grouped together at the head ends of the cylinders, together with the discharge pipes, so that the temperature and volume of any circulation can be determined conveniently while manipulating the corresponding valve.

TESTS AND EFFICIENCIES.

Under the average operating conditions of the Independence plant during a thirty-day test, including periods of light as well as full loading, a kw-hour was produced for every 20 cu. ft. of gas taken by the engines. This natural gas, which comes from the Oklahoma fields, has a fuel value of about 950 lb.-Fahr. heat units per cubic foot. Under conditions of half to 60 per cent load at the time of another test the engine produced a hp-hour on 11.75 cu. ft. of gas. These results were taken from tests made at the local plant, during the course of which the indicator card reproduced herewith (Fig. 4) was made.

The Snow engine, which is now used for Sunday service and during emergencies, has recently been equipped with a set of mixing valves similar to those on the 500-kw engine. The cylinders of the Snow unit are 14 in. by 21 in., while those of the Westinghouse vertical three-cylinder unit measure 13 in. by 14 in.

Compressed air for starting up the engines is furnished by a 5-hp motor driving a Sterling compressor pump. This motor, like all the other station equipment, is of the alternating-current type. The gas supply lines for the engines is piped in at high pressure to reducing valves and gasometers, which lower its pressure from 3.5 lb. per square inch to that equivalent to 3 in. or 4 in. of water column. All gas used in the plant is measured by a pair of meters arranged in parallel in the supply line in the station.

The exhaust gases from the engines are led outside the building to a muffler pit 8 ft. square and 8 ft. deep, covered over with loose boards and earth. As they leave the engine these gases are partially cooled by introducing into the pipe just enough water to absorb most of the heat in being vaporized into steam. From the muffler pit several 8-in. pipes extend up the side of the plant wall, opening to the atmosphere, although all but one of these lines are ordinarily kept closed. From the muffler another pipe, 12 in. in diameter, is led up and into the cooling tower for the jacket water, inducing a draft which is effective in producing several degrees lower temperature of the water leaving the tower.

JACKET WATER-COOLING SYSTEM.

The cooling tower is a frame structure 45 ft. high and 14 ft. square, sheathed with pressed steel and painted white. Surmounted by a row of electric lamps beneath its flared cornice, its appearance is not objectionable by day or night. Inside the tower at 6-in. distances are hung sheets of ¼-in. mesh netting 14 ft. wide and 28 ft. long. As the water is poured over these it breaks up into thin sheets, spanning the interstices, and thus presents nearly 10,000 sq. ft. of cooling surface to the upward ascending air currents. Besides the temperature of the water itself additional up-draft is produced by the exhaust line from the muffler pit, the use of which is said to cause 8 deg. Fahr. difference in the final temperature of the water. The Independence plant benefits from the very low humidity which, even on hot days, prevails in the southeastern section of Kansas, making it sometimes possible to cool the circulation water down to 96 deg. when the atsmosphere itself is 104 deg.

The circulation water leaves the engine cylinders at a temperature of about 140 deg. and is discharged into a hot-well, 4 ft. by 6 ft. in area and 4 ft. deep, just alongside the muffler pit. From this hot-well one of two 4-in. centrifugal pumps, driven by a 15-hp General Electric induction motor,

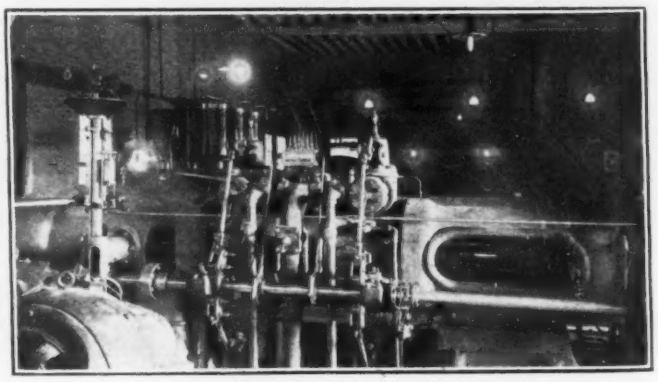


Fig. 3—Details of Unique Valve Mechanism of Large Engine.

elevates the water to the top of the cooling tower, down which it trickles to the basin at its base. From this basin the other centrifugal pump of the pair then again elevates the water to the 20-ft. storage tank, from which the engine-jacket circulating system is supplied.

The switchboard for the plant comprises the three generator panels, three line panels and two rectifier panels for the magnetite-arc lamps used to light Independence's streets. The constant-current transformers are mounted on a gallery behind the switchboard. A hand-operated traveling crane is installed over the 500-kw engine. This latter unit is also equipped with an automatic safety stop, which prevents any tendency to overspeeding by at once opening the ignition circuit. In a hole drilled in the 20-in. by 21-in. face of the 12-ft., 32-ton flywheel, a steel rod suspended by a spring is mounted. Should the flywheel reach a speed above six revolutions above its normal rate of 150 r.p.m. the centrifugal force developed causes this rod to protrude out of the hole, striking and opening a switch in the ignition circuit. This safety stop is tested regularly every Sunday morning when the engine is ready to be shut down by holding the governor and allowing the stop to break the ignition, in this way stopping the engine.

Fig. 4—Indicator Card Taken from 500-kw Gas Engine.

USES OF ELECTRIC ENERGY.

At the present time the Independence Electric Company has 800 kw of connected motor load. Among its larger "power" customers are the local brickyard, planing mill, machine shops and local repair shops. The Coffeyville Vitrified Brick & Tile Company has 200 hp connected load of 220-volt, three-phase motors in daily use. A 40-hp motor drives its auger mixer, two others operate the dry-pans, a 30-hp motor runs the bucket crane, a 15-hp motor drives the repress machine, and a 10-hp motor is installed in the dry-shed.

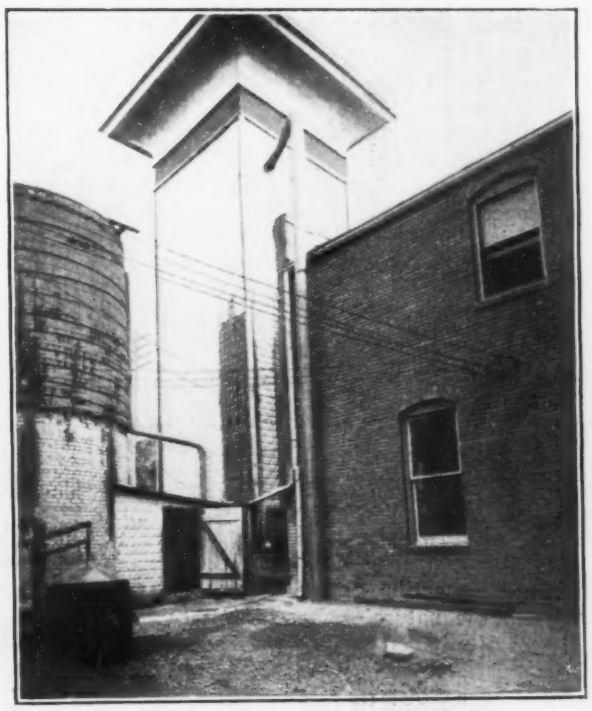


Fig. 5—Cooling-Tower Muffler Pit and Exhaust and Water Circulating System.

Another unique motor application on the company's lines is an electric road roller, energized through a portable transformer from the 2300-volt, single-phase distribution lines. The roller weighs nearly 8 tons and is operated at a cost less than the maintenance of a steam roller. The machine was designed and built in Independence.

Forty electric pleasure vehicles in a town of 12,000, not exclusively a residence suburb, is an unusually high per-capita ratio and one that is probably unequaled by any other late-frontier settlement in the West. The contributing causes to this unusual development in Independence have been its 35 miles of paved streets, a numerous class of wealthy residents and satisfactory central-station service. Two public garages do an electric-vehicle charging and stabling business, and several private rectifier sets are installed. The latter obtain battery-charging service at 8 cents per kw-hour.

Mr. W. R. Murrow is secretary and general manager of the Independence Electric Company. Mr. J. Hill is engineer of the plant and Mr. C. Hill is chief electrician.

HYDROELECTRIC CENTRAL STATION AT SKAGWAY, ALASKA.

Operation by High-Head Pelton Wheel in Summer and Steam Turbine in Winter.

SKAGWAY, Alaska, situated 1000 miles north of Seattle, is reached by steamers through the famous "inside passage" and a narrow mountain inlet, called Lynn Canal. This town is the terminus of the White Pass & Yukon Railroad, which gives a daily service over the White Pass to White Horse, the head of navigation on the Yukon River. At the time of the rush of gold seekers in 1898 and 1899 the town had a population of 5000, but at the present time the population is about 800.

Skagway, being located in a valley surrounded by high snow-clad mountains, is ideally situated for the utilization of hydraulic power and good use is made of the power available. The Home Power Company, which has a modern hydraulic and steam electric plant in the town, procures water-power from the lakes and wood for fuel from the mountain sides.

At an elevation of 500 ft. above the valley is Lake Dewey, a beautiful body of water ¾ mile in length and 700 ft. in width. A dam about 700 ft. long was installed at one end, a shorter dam was placed at the other end, thereby increasing the size of the lake. Nearly 3000 ft. in elevation is Upper Lake Dewey, 1800 ft. in length by 800 ft. in

Fig. 1—Power Plant of the Home Power Company, Skagway, Alaska.

width, the water from it flowing in a succession of falls down the mountainside into the lower lake. No attempt is made to store any large body of water in these lakes, but use is made of the supply from melting snows and glaciers, this being sufficient throughout most of the year for power purposes and the town's use; late in the winter only enough

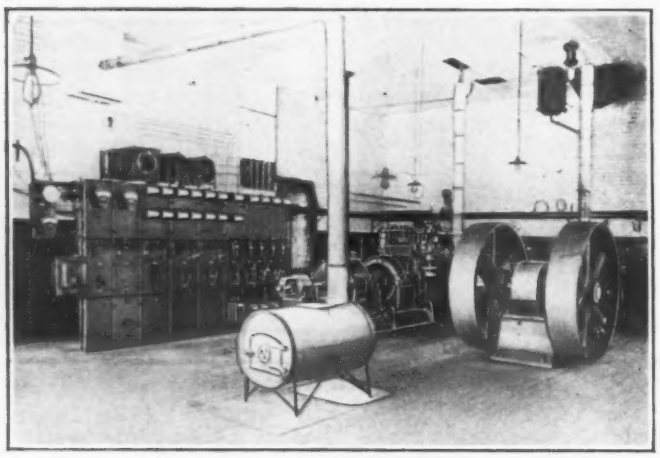


Fig. 2—Steam-Generating Equipment and Switchboard.

water for the town's use and the requirements for condensing purposes in the plant is available.

Two years ago the plant's water-power unit consisted of a Tutthill waterwheel directly connected to a 100-kw Stanley alternator, but since that time more modern machinery has been installed to meet the increasing demands.

The Stanley alternator was superseded by a General Electric 125-kw, 2300-volt, two-phase, revolving-field generator running at 900 r.p.m. and a 5-kw, 125-volt exciter belted from the generator shaft and running at 2000 r.p.m.

A Pelton waterwheel was also installed. This is now used almost continuously. There are two rows of buckets on the wheel shaft, the water supply being controlled by two hand-operated needle nozzles. A General Electric 250-kw, 2300-volt, two-phase, revolving-field generator is connected by flexible coupling to the waterwheel shaft, which runs at 600 r.p.m. A 15-kw, 125-volt exciter is belted from the generator shaft. The speed of the unit is main-

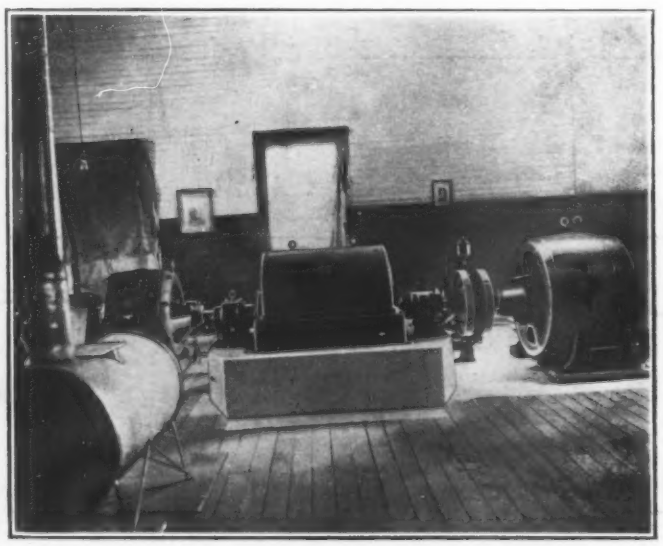


Fig. 3—Hydroelectric Generating Equipment.

tained by a Pelton oil-pressure governor belted from the main shaft.

Water is furnished from the lower lake reservoir by a 12-in. steel pipe line, giving a pressure of 215 lb. per square inch being delivered to both waterwheels. From about Dec. 15 to April 15, owing to a scarcity of the water supply, the plant is operated by steam power. The steam equipment is quite complete. It consists of one Curtis steam-turbine set of 100-kw rating running at 3600 r.p.m. and furnishing 2300-volt, two-phase service. The turbine exhausts into a jet condenser. A Snow single-cylinder air pump, running condensing, maintains a vacuum of from 24 in. to 26 in. The injector water is furnished by a 2-in. line at 60 lb. pressure. The air pump discharges into a hot-well.

A tandem-compound Ideal engine is belted to the 125-kw generator, the waterwheel being disconnected therefrom for this purpose. This engine exhausts into a Blake barometric condenser which is supplied with ejector water by a 3-in. line at 60 lb. pressure. This condenser discharges into the hot-well. The boilers consist of two B. & W. water-tube boilers, each having a steam drum 42 in. in diameter and 20 ft. in length and seventy-two 4-in. tubes. Each furnace is 7 ft. x 5 ft. in size and wood is used as fuel. The wood is purchased at $5.50 per cord delivered to the boiler-room on cars, each containing one cord. A gage pressure of 160 lb. is maintained, the safety valves being set at 165 lb. From five to seven cords of wood are burned on a twenty-four-hour run. Only one boiler is used, the other being kept in readiness.

Either of the two Snow duplex pumps are used for feeding water to the boiler from the hot-well through two closed heaters. A Hoppes purifier has been installed, but owing to the good quality of the feed water it is not used. The Ideal engine is supplied with steam from the boiler header by a 6-in. line and the steam turbines by a 3-in. line.

The switchboard contains eight black-slate panels as follows: Three machine panels, with two-phase oil switches and field-circuit switch and rheostat; two exciter panels with exciter switch and rheostat; two panels with oil switches for motor-service lines, and one panel with two single-phase oil switches for lighting circuits.

The switchboard is equipped with direct-current ammeters and voltmeters; alternating-current ammeters, voltmeters, synchronous indicator and watt-hour meters on motor and lighting-service circuits. All distributing switches are provided with trip coils and time-limit relays. All of the wiring from the machines to the switchboard is placed in conduit.

Recently a new set of 2300-volt busbars has been installed with an oil switch as a circuit between this set and the older set of busbars. By this arrangement one unit may be operated on the motor-service lines, another one on lighting circuits. Although this mode of operating is not an economical one it is necessary to give good lighting service in spite of the fluctuating motor load on the system. A voltage regulator is used in connection with the governor when motor service is furnished, but this does not always provide good lighting service when the motor demands are heavy.

The White Pass & Yukon Railway formerly had its own steam station and also furnished some energy for commercial lighting, but it now purchases all of its energy from the Home Power Company. The railway shops are equipped with two-phase, 220-volt motors to run lathes, air compressor, pumps, etc.

With the exception of about three months in the summer, when the natural light exists throughout the night, the streets are lighted artificially by seventy 16-cp multiple-carbon lamps. A series-tungsten system is being planned for the future. All energy for lighting is delivered by transformers with 110-volt secondary emf, both carbon and tungsten lamps being used. A day lighting service is maintained from motor-service lines to a number of consumers, but the main lighting circuits are in service only at night, the street-lighting energy being obtained from the same circuits.

The Tuthill waterwheel unit having no governor is used only on the lighting load, but the Pelton unit is run con-

stantly, except on Sunday when no motors are run, and it carries all the load in the summer months.

A low-pressure water main is used in the station for the operation of a waterwheel to which are belted two 0.5-hp, 110-volt generators. These furnish energy for operating the telegraph and telephone lines of the railway company. A small Racine steam engine is provided for use when necessary in place of the waterwheel.

A large percentage of the customers have meters and a rate of 10 cents per kw-hour is charged. Flat-rate customers are charged $1 per month for each 16-cp lamp. Energy for traction power and lighting is sold to the railroad company at 2.5 cents per kw-hour. A rate of $1.25 per month for each 16-cp street lamp is given to the town. In the winter time when the lighting circuits are in service for about eighteen hours a day the output on them is about 850 kw-hours, but in the summer months when the circuits are in service for only about twelve hours a day with no street lamps in use the output is about 375 kw-hours. The motor load for ten hours, in the day time, is about 250 kw-hours for the whole year. Motor service is usually furnished only in the daytime.

The manager of the company is Mr. Charles Nye, the secretary is Mr. L. A. Harrison and the station is in charge of Mr. Gordon Swan, who is chief engineer for the company. Though this electric station is situated in the Far North and often is the cause of surprise to visitors, it is able to meet any demands made upon it for motor or lighting service.

EUROPEAN APPARATUS AND PROCESSES FOR THE MANUFACTURE OF ELECTROLYTIC HYPOCHLORITE.

A Promising Source of Central-Station Income from Laundries and Fabric-Cleaning Works.

BY JOHN B. C. KERSHAW.

ALTHOUGH the time has not yet arrived when one-half the world lives by "taking in the washing" of the other half, a larger proportion of the population of cities is engaged in cleaning, bleaching and laundry occupations than is generally recognized, and the last census returns show that in the United States this proportion of the population is rapidly increasing. Laundries and the so-called dry-cleaning works multiply and increase in size with astonishing rapidity. The up-to-date central-station manager should find, therefore, among these laundries and dry-cleaning works (many of large size) a profitable and useful outlet for electric energy. Altogether apart from the question of equipping these works with electric motors in place of hand or steam-driven machines, there is the possibility of installing electrolytic bleaching apparatus which will enable cleaner and whiter goods to be produced than with ordinary bleaching agents, without any great increase in the cost of treatment, and with less destructive effects upon the fabric.

The practical use of electrolysis to produce bleaching solutions dates from 1890, when a Frenchman named Hermite introduced his process at a wood-pulp factory at Stjernfors in Sweden. Since that date a very large number of cells for producing hypochlorite by the electrolysis of brine have been patented and tried experimentally. In the writer's monograph upon the "Electrochemical and Electrometallurgical Industries of England," published in 1907 by Knapp, of Halle (as Vol. 28 of the German series on Applied Electrochemistry), information will be found relating to the electrolyzers of Watt-Hermite, Vogelsang, Atkins and Woolf, and the practical trials that had been made with these in the years 1890-1905 in the United Kingdom. These early attempts to apply electrolytic hypochlorite to various bleaching or deodorizing purposes failed, chiefly owing to defects in the apparatus, and it is only within the last few years that success has been attained in producing a satisfactory apparatus and a fairly stable bleaching fluid at a reasonable cost. For the sodium hypochlorite produced by the electrolysis of brine it is claimed that its efficiency as a bleaching agent is much higher than that of calcium hypochlorite (the active agent of "bleach" or "chloride of lime"), while its destructive action in weakening the fiber of the goods is less. As regards the superior bleaching efficiency of the electrolytic solution, Drs. Kind, Weindel and Fraas have investigated the somewhat exaggerated claims made on its behalf and find that:

(1) Using equal amounts of chlorine, and working under similar conditions, the electrolytic bleaching liquor gives the better bleaching effect.

(2) If the bleaching effect be stopped at the same degree of whiteness the use of electrolytic liquor enables a saving of 5 per cent of chlorine to be made when working with alkaline liquor.

(3) The presence of an excess of bleaching liquor does not alter these comparative results.

(4) Increase of alkalinity diminishes the rate of bleaching but increases the final effectiveness of the bleach in the case of both electrolytic and "bleaching-powder" solutions.

In the light of these conclusions central-station managers have a good case to present when urging the adoption of electrolytic methods of preparing the bleaching solutions required by laundries and cleaning works. The chemistry of the electrolytic hypochlorite process and the details of construction of three forms of apparatus which have received practical trial in Europe are dealt with below.

THEORY OF THE ELECTROLYTIC HYPOCHLORITE CELL.

The electrolysis of solutions of chlorides always produces chlorine at the anode, and the hydrate of the base (sodium, potassium or magnesium) at the cathode. In the electrolytic alkali processes the aim of the inventor has been to effect removal of these products before they can react one with the other. In the electrolytic bleaching processes the chlorine and the caustic hydrate are allowed to react in order that the chemical changes represented by the following equations may occur:

$$3\,NaOH + 3\,Cl = 3\,NaOCl + 3\,HCl. \qquad (1)$$

Sodium hydrate and chlorine yield sodium hypochlorite and hydrochloric acid.

$$3\,NaOH + 3\,HCl = 3\,NaCl + 3\,H_2O. \qquad (2)$$

Sodium hydrate and hydrochloric acid yield sodium chloride and water.

If the temperature be allowed to rise above a certain point a further action will occur and chlorate will be produced. It is therefore necessary in all electrolytic bleaching and disinfecting processes to pay great attention to the circulation and to the temperature, as chlorates are useless for bleaching purposes.

THE SIEMENS ELECTROLYZER.

The Siemens form of hypochlorite cell is based on the patents of Dr. Karl Kellner, of Vienna, one of the early workers in applied electrochemistry. The following description is taken from an article in the *Chemical Trade Journal*, March 27, 1909:

"The Siemens 'bleaching electrolyzer' consists of a flat tank of substantial construction divided into sections by vertical glass plates. By this means a series of decomposition cells is formed; these are 'pitched' in such a manner that the solution of salt or bleaching lye must flow horizontally in a zig-zag path from cell to cell, subjected in each cell to the action of the electric current. This arrangement permits making bleaching electrolyzers for connection to any continuous-current supply at any voltage, but it is advisable not to use more than 150 volts.

"The electrodes are constructed of platinum-iridium wire net and are arranged horizontally, one above the other, in such a manner that the anode or positive electrode lies below the cathode or negative electrode. This arrangement causes layers of fluid to be formed in the electrolyte

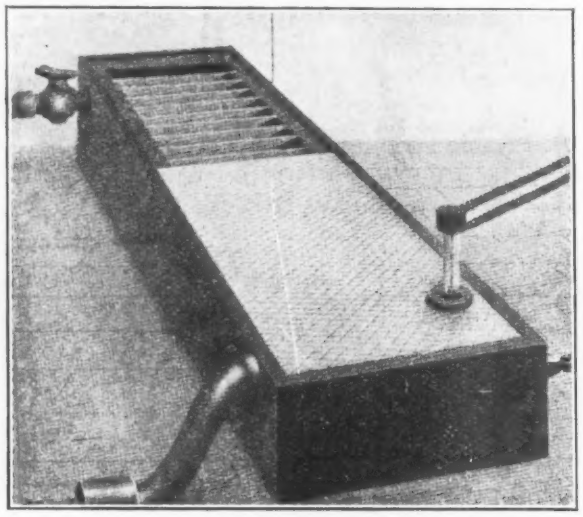


Fig. 1—Kellner's Electrolyzer.

and effects the most efficient utilization of the electrical energy. The electrodes are so arranged that no internal electrical connections of any kind are necessary. This is a great practical advantage, as connections to electrodes are well known to give considerable trouble. The Siemens electrolyzer has only two electric terminals, designed as a result of special experience, which are built into the apparatus in such a manner that it is impossible for them to be attacked by electrolytic action. The electrodes are so arranged that they can be taken out of the electrolyzer at any time for purposes of adjustment and replaced quickly. Fig. 1 shows a working model of this form of electrolyzer.

"The fitting up and working of a modern electrolytic bleaching apparatus of the Siemens type is extremely simple. The necessary quantity of salt is first dissolved in water, the solution being allowed to clarify in a second vessel. For this purpose wooden vats or tanks of brickwork, etc., are used, or the existing tanks employed for dissolving chloride of lime are generally suitable. The clear solution of salt passes into a cooling vessel, whence it is forced continuously through the electrolytic apparatus by means of a small centrifugal pump. In the course of this circulation the solution of salt is gradually decomposed by the electric current, and the bleaching lye in passing through the above-mentioned cooling vessel is kept cool by means of coils of lead pipes through which water is passed and is thus maintained at the low temperature necessary for a good output. The circulation continues to take place until the desired concentration of active chlorine has been attained. This type of cell has attained extended use in Germany and Austria in laundries and chemical cleaning works."

HASS AND OETTEL ELECTROLYZER.

The Haas and Oettel electrolyzer is distinguished from that of Kellner by the use of carbon as electrode material and by the application of the hydrogen gas liberated at the cathode to effect automatic circulation of the liquid in the vessel containing the mixed brine and hypochlorite solutions. The following description is taken from an article by E. Reuss, which appeared in the issue of the London *Electrical Review*, April 15, 1910:

"The electrolyzer consists of a rectangular stoneware box divided by the carbons into some thirty compartments, each chamber having a hole at the bottom and another at the side about 2 in. from the top. The first and last carbons in the set form respectively the anode and the cathode of the apparatus.

"The electrolyzer is placed in a stoneware tank measuring about 6 ft. long, 4 ft. wide and 3 ft. deep, and this is filled with brine holding about 15 per cent of common salt in solution. As soon as the circuit is completed a lively effervescence commences in the cells, due to the evolution of hydrogen, raising the level of the liquid inside the electrolyzer and causing it to overflow through the openings at the sides, while it is replaced by fresh liquor entering through the holes in the bottom of the cell.

"As the passage of the current produces heat, the temperature is kept down by passing cold water through coils placed on both sides of the electrolyzer. The circulation is entirely automatic and is very effective.

"Continuous current is employed. Using about 80 amp and 110 volts, ten hours is required to complete the electrolysis of 10.5 kg of chlorine, the equivalent of about 66 lb. of bleaching powder."

A very large number of Haas and Oettel electrolyzers are now in use for laundry purposes in England and America, as well as on many of the steamship lines. The writer has also inspected an installation which is giving satisfaction at a large dyeing and cleaning works in the vicinity of Liverpool. Fig. 2 shows a working installation of this electrolyzer.

THE HERMITE ELECTROLYZER.

An improved form of the Hermite hypochlorite cell has been in use since 1905 by the sanitary authorities at Poplar, London, for manufacture of a disinfecting fluid, and although the writer has no definite knowledge that this cell has been applied in laundry and bleaching work, it will be useful to include a description of it in this article. A mixture of sodium and magnesium chloride is used as the electrolyte, sodium hydrate as a preservative being added to the solution as it leaves the cell. The description is taken from a paper by C. V. Biggs read before the Faraday Society in London, November, 1906:

"The system adopted at Poplar is to mix a certain quantity of fluid in an elevated tank and then to allow this fluid to flow through four double troughs or cells, placed one above the other, so that the liquid descends continuously by gravity. Each trough is divided laterally by a partition and in each of the two divisions five distinct 'elements'

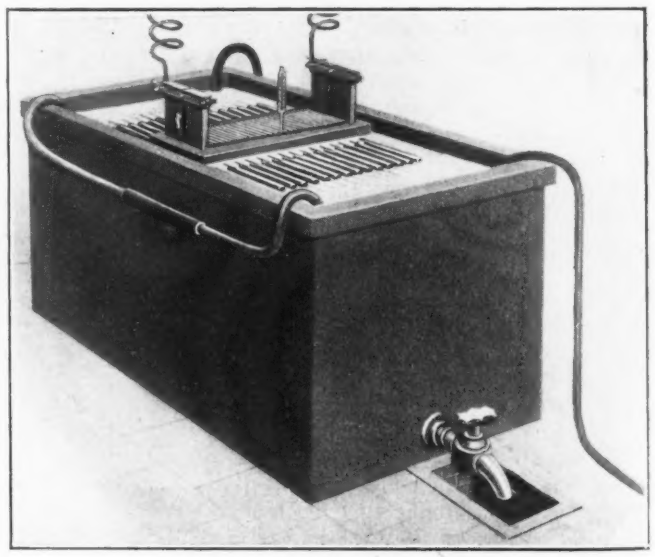


Fig. 2—Haas and Oettel Electrolyzer.

(consisting of one positive and two negative plates) are suspended. The positive plates are of thin platinum wire wound upon slate slabs; the negative plates are of zinc. There are thus four troughs, each containing ten elements, or forty cells in all. The liquid enters through the funnel

passes along the front division of the top trough, back through the division behind, over a weir and into a subdivision, from which it is drawn off by the bent-glass tube discharging into the second funnel. It then passes along the front division, back through the division behind, over the weir into the pocket of the second trough and so on to the final bent tube, which discharges it into a carboy. A bottle arranged at the right-hand side of the tier of cells supplies the sodium hydroxide used as a preservative, which flows drop by drop into the carboy as it is filling and serves to neutralize free hypochlorous acid. As the liquid passes through the troughs it is subjected to the action of a current of 15 amp at 230 volts, which is 5.6 volts per cell."

COSTS AND CONCLUSIONS.

It is unnecessary in this article to examine in a detailed manner the various conflicting data that have been published concerning the comparative costs of bleaching with electrolytic hypochlorite and with ordinary bleaching powder. Independent and unbiased investigators admit that the electrical hypochlorite solution is the more expensive of the two. The present writer in the discussion upon Mr. Biggs' paper on the Hermite cell, read before the Faraday Society in 1906, made the following statement:

"For certain purposes hypochlorite of soda is much to be preferred to hypochlorite of lime, the active agent in ordinary bleaching powder, and in these cases the higher cost of the former, even when produced by the electrolysis of brine, is unlikely to retard its utilization as soon as a cheap, reliable and durable electrolytic cell for producing it is placed upon the market. The Hermite cell and process in its original form did not fulfil these conditions, and the same judgment must be passed upon many of the patented processes which have since been brought before the public."

The cells described above, however, appear to fulfil the required conditions as cheap, reliable and durable cells for the production of sodium hypochlorite solutions from brine by electrolysis. As the operation of these cells does not require skilled attention and can be rendered intermittent by well-known devices, they are eminently suited for installation in laundries and bleach works.

THE SEPARATION OF AN ALTERNATING-CURRENT WAVE INTO ITS HARMONIC COMPONENTS.

Comparison of Fischer-Hinnen and Runge Methods and Simplified Means of Applying the Latter.

BY C. A. PIERCE AND WILLIAM ANDERSON.

THERE are many different analytical and graphical methods for separating a periodic alternating wave into its harmonic components. Few of these can be considered usable, however, if the wave is at all complex and accurate results are desired. One of the methods that have been used a great deal was devised by Mr. J. Fischer-Hinnen.[1] Another one was devised by Mr. C. Runge.[2] The purpose of this article is to compare the two methods, to call attention to the superior accuracy and greater brevity of the latter and to give a new table, constructed according to Runge, for the accurate analysis of an alternating-current wave which contains more than the first two or three lower harmonics.

According to Fourier, any periodic alternating wave can be expressed by the trigonometric series,

$$e = A_1 \sin \theta + A_2 \sin 2\theta + A_3 \sin 3\theta + \quad (1)$$
$$+ \tfrac{1}{2} B_0 + B_1 \cos \theta + B_2 \cos 2\theta + B_3 \cos 3\theta +$$

To express an alternating-current wave by means of this series it is necessary to determine the constants $\frac{1}{2} B_0$, A_1, B_1, etc. The constant $\frac{1}{2} B_0$ can be made equal to zero by drawing the axis of the complex wave so that the positive and negative loops are equal. The terms containing the coefficients with the even subscripts vanish in the case of alternating-current waves in which the negative loops are repetitions of the positive loops, the ordinates being negative instead of positive. With these simplifications, equation (1) reduces to

$$e = A_1 \sin \theta + A_3 \sin 3\theta + A_5 \sin 5\theta +$$
$$+ B_1 \cos \theta + B_3 \cos 3\theta + B_5 \cos 5\theta + \quad (2)$$

Runge's method, as originally published, considered the most general case corresponding to equation (1). Fischer-Hinnen's method was developed for the case where the axis is drawn symmetrically with respect to the positive and negative loops, that is, the constant term, $\frac{1}{2} B_0$, is eliminated from equation (1). Either method can be simplified so as to apply to equation (2) and the computations are more than halved thereby. Since practically all alternating-current waves can be accurately expressed by equation (2), which means that even harmonics are not present, the discussion to follow will consider this case alone.

The method of Fischer-Hinnen consists in determining separately, from ordinates measured on the complex wave, the components of each harmonic beginning with the third. The sine components of all of the harmonics above the first are combined with a certain ordinate of the complex wave to get the sine component of the first harmonic, and the cosine component of the first harmonic is obtained in a similar manner. The method would be ideal for determining any one harmonic directly were it not necessary to add a correction to the sine and cosine components of that harmonic whenever harmonics of three, five, etc., times the frequency of the desired harmonic are present. The higher harmonics are frequently of no practical importance, but there is no sure way of finding this out without determining their value.

The necessity of carrying alternating-current wave analyses to include harmonics higher than the third and fifth becomes greater as electrical engineering advances. This is especially true wherever capacity and resonance are predominant. It is true in the laboratory, where complex waves are frequently built up by means of alternators directly coupled together.

In cases such as those above the method of Fischer-Hinnen fails to be satisfactory in five ways:

a. No harmonic is exactly determined if harmonics of three, five, etc., times its frequency are present unless corrections are made which necessitate the determination of these higher harmonics.

b. The first harmonic components cannot be determined exactly unless all of the higher harmonics are known. The neglect of any component introduces an error into the corresponding component of the first harmonic equal to the component neglected.

c. The errors discussed under *a* and *b* affect the phase relations as well as the amplitudes of the harmonic components.

d. There is no easy way of ascertaining when all of the harmonics have been obtained.

e. To determine, even approximately, a wave that is at all complex necessitates the measuring of a great many different ordinates on the complex wave.

As an illustration of the last item it is necessary to measure twenty-six different ordinates to determine the first, third, fifth and seventh harmonics, assuming no higher harmonics; ninety-eight different ordinates to determine the odd harmonics up to and including the fifteenth harmonic, and about 518 different ordinates to determine the first eighteen odd harmonics under the same conditions. In an article on the flux distribution in an alternator[3] the analyses

[1] *Elektrotechnische Zeitschrift*, p. 396, Vol. 22, 1901. See also P. M. Lincoln, *Electric Journal*, p. 386, Vol. 5, 1908.

[2] *Zeitschrift für Mathematik und Physik*, p. 443, Vol. 48, 1902-03. See also S. P. Thompson, *Proc.* Physical Society of London, p. 443, Vol. 19, 1904.

[3] C. A. Adams, *Trans.* A. I. E. E., Vol. 28, Part II, p. 1070.

made by this method were carried to include the nineteenth harmonic, which made it necessary to determine about 166 different ordinates on each wave. In one instance the analysis was extended to include the twenty-seventh harmonic, which took about 310 different ordinates.

Whenever it is necessary to determine more than one or two harmonics in a complex wave the nine or eighteen odd harmonic method after Runge is much shorter. In his original article two tables are given, one for all harmonics up to and including the fifth, and the other for all harmonics up to and including the seventeenth. Prof. S. P. Thompson gives a table for all odd harmonics up to and including the eleventh harmonic.

and 180 deg., 5 and 185 deg., 10 and 190 deg., and 15 and 195 deg. The resulting equations were:

By Runge's method.[4]

$$e = 100.0 \sin \theta + 30.0 \sin 3\theta + 10.0 \sin 5\theta$$
$$= 100.0 \sin \theta + 30.0 \sin 3\theta + 17.3 \sin (5\theta + 29.9)$$
$$= 100.0 \sin \theta + 30.0 \sin 3\theta + 26.5 \sin (5\theta + 19.1)$$
$$= 100.0 \sin \theta + 30.0 \sin 3\theta + 30.0 \sin 5\theta$$

SINE COMPONENTS.

	1 35	3 33	5 31	7 29	9 27	11 25	13 23	15 21	17 19
Sin 5 deg.	S_1		S_7	S_5		$-S_{13}$	$-S_{11}$		S_{17}
" 10 "	S_2	S_1'	$-S_{14}$	$-S_{10}$		$-S_{10}$	S_{14}	S_5'	S_2
" 15 "	S_3		S_{15}	S_{15}		S_3	$-S_3$		$-S_{15}$
" 20 "	S_4		$-S_8$	$-S_{16}$		S_{16}	$+S_8$		$-S_4$
" 25 "	S_5		S_1	S_{11}		S_7	S_{17}		S_{13}
" 30 "	S_6	S_2'	S_6	$-S_6$		$-S_6$	S_6	S_2'	S_6
" 35 "	S_7		$-S_{13}$	S_1		$-S_{17}$	$-S_5$		$-S_{11}$
" 40 "	S_8		S_{16}	S_4		$-S_4$	$-S_{16}$		$-S_8$
" 45 "	S_9	S_3'	$-S_9$	$-S_9$	S_1''	S_9	$-S_9$	$-S_3'$	S_9
" 50 "	S_{10}		S_2	S_{14}		S_{14}	S_2		S_{10}
" 55 "	S_{11}		S_5	$-S_{17}$		S_1	S_{13}		$-S_7$
" 60 "	S_{12}	S_4'	$-S_{12}$	S_{12}		$-S_{12}$	S_{12}	$-S_4'$	$-S_{12}$
" 65 "	S_{13}		S_{17}	$-S_7$		$-S_{11}$	S_1		S_5
" 70 "	S_{14}		$-S_{10}$	S_2		S_2	$-S_{10}$		S_{14}
" 75 "	S_{15}	S_5'	S_3	S_5		S_{15}	$-S_{15}$	S_1'	$-S_3$
" 80 "	S_{16}		S_4	$-S_8$		S_8	$-S_4$		$-S_{16}$
" 85 "	S_{17}		$-S_{11}$	S_{13}		$-S_5$	S_7		S_1
" 90 "	S_{18}	S_6'	S_{18}	$-S_{18}$	S_2''	$-S_{18}$	S_{18}	S_6'	S_{18}
I. Sum 1st. cols.									
II. Sum 2nd Cols.									
I. − II.									
I. + II.									
$\frac{1}{18}$(I. − II.)	A_1	A_3	A_5	A_7	A_9	A_{11}	A_{13}	A_{15}	A_{17}
$\frac{1}{18}$(I. + II.)	A_{35}	A_{33}	A_{31}	A_{29}	A_{27}	A_{25}	A_{23}	A_{21}	A_{19}

By Fischer-Hinnen's method,[4]

$$e = 90.0 \sin \theta + 30.0 \sin 3\theta + 20.0 \sin 5\theta$$
$$= 92.6 \sin \theta + 30.0 \sin (3\theta - 12) + 20.0 \sin (5\theta - 20)$$
$$= 98.7 \sin \theta + 30.0 \sin (3\theta - 19) + 20.0 \sin (5\theta - 31.8)$$
$$= 105.4 \sin \theta + 30.0 \sin (3\theta - 14.1) + 20.0 \sin (5\theta - 23.5)$$

COSINE COMPONENTS.

	1 35	3 33	5 31	7 29	9 27	11 25	13 23	15 21	17 19
Sin 5 deg.	d_{17}		d_{11}	$-d_{13}$		d_5	$-d_7$		d_1
" 10 "	d_{16}	d_5'	$-d_4$	d_8		d_3	$-d_4$	d_1'	d_{16}
" 15 "	d_{18}		d_3	$-d_3$		$-d_{15}$	$-d_{15}$		$-d_3$
" 20 "	d_{14}		$-d_{10}$	d_2		$-d_2$	d_{10}		$-d_{14}$
" 25 "	d_{13}		d_{17}	$-d_7$		$-d_{11}$	d_1		d_5
" 30 "	d_{12}	d_4'	d_{12}	d_{12}		d_{12}	d_{12}	d_4'	d_{12}
" 35 "	d_{11}		$-d_5$	$-d_{17}$		d_1	$-d_{13}$		$-d_7$
" 40 "	d_9		d_2	d_{14}		$-d_9$	$-d_9$		d_9
" 45 "	d_{10}	d_3'	$-d_9$	$-d_9$	d_1''	d_{14}	$-d_2$	$-d_2'$	$-d_{10}$
" 50 "	d_7		d_{16}	$-d_4$		$-d_4$	d_{16}		d_8
" 55 "	d_8		d_{13}	d_1		$-d_{17}$	d_5		$-d_{11}$
" 60 "	d_6	d_2'	$-d_6$	$-d_6$		d_6	d_6	$-d_2'$	$-d_6$
" 65 "	d_5		d_1	d_{11}		d_7	d_{17}		d_{13}
" 70 "	d_4		$-d_8$	$-d_{16}$		$-d_{16}$	$-d_8$		d_4
" 75 "	d_3	d_1'	d_{15}	$-d_{15}$		$-d_3$	$-d_3$	d_3'	$-d_{15}$
" 80 "	d_1		d_{14}	d_{10}		$-d_{10}$	$-d_{14}$		$-d_2$
" 85 "	d_2		$-d_7$	$-d_5$		d_{13}	d_{11}		d_{17}
" 90 "	d_0	d_0'	d_0	d_0	d_0''	d_0	d_0	d_0'	d_0
I. Sum 1st Cols.									
II. Sum 2nd Cols.									
I. + II.									
I. − II.									
$\frac{1}{18}$(I. + II.)	B_1	B_3	B_5	B_7	B_9	B_{11}	B_{13}	B_{15}	B_{17}
$\frac{1}{18}$(I. − II.)	B_{35}	B_{33}	B_{31}	B_{29}	B_{27}	B_{25}	B_{23}	B_{21}	B_{19}

In order to illustrate the errors introduced by determining too few harmonics a complex wave was built up from the equation

$$e = 100 \sin \theta + 30 \sin 3\theta + 20 \sin 5\theta + 10 \sin 7\theta,$$

and the wave was analyzed first by Runge's five-harmonic method and then by Fischer-Hinnen's method determining only the first three odd harmonics. The wave was analyzed four times by each method, using the part between $\theta = 0$

If other higher harmonics had been neglected other changes would have been made in the resulting equations.

[4] The sine and cosine components are here combined, as is customary in this work. Equation (2) can be written,

$$e = C_1 \sin (\theta + \Phi_1) + C_3 \sin (3\theta + \Phi_3) + \text{etc.},$$

where $Cn = \sqrt{A^2n + B^2n}$ and $\Phi n = tan^{-1}\frac{Bn}{An}$

In using the latter equation, care must be exercised to locate Φn in the proper quadrant.

The authors have found that it is seldom safe to use a table giving less than the first nine odd harmonics, and it is frequently necessary to use a table for the first eighteen odd harmonics. This is not so very laborious by Runge's scheme since it is necessary to compute only the harmonics desired. The nine odd harmonic scheme is not reproduced here since it can be deduced easily from the eighteen odd harmonic scheme, or it can be deduced from Runge's original article, or the table can be built up easily from the equations,[8]

$$A_m = \frac{2}{n+1} \sum_{k=o}^{k=n} y_k \sin k\left(m \frac{\pi}{n+1}\right) \qquad (3)$$

$$B_m = \frac{2}{n+1} \sum_{k=o}^{k=n} y_k \cos k\left(m \frac{\pi}{n+1}\right) \qquad (4)$$

where m stands for any harmonic component, as the first, third, etc., $n+1$ is the number of ordinates taken on a half wave and $\frac{\pi}{n+1}$ is the distance between ordinates. A table for any number of odd harmonics can be built up by means of these equations.

To analyze a wave by means of the eighteen odd harmonic scheme, which is given below, draw the Θ-axis so that the positive and negative loops are equal and measure the ordinates over a half wave at 5-deg. intervals. The first point of the half wave may be taken anywhere on either loop.[9] Let the ordinates, as measured in order, be represented by y_o, y_1, y_2 . . . . y_{35}. Write down the ordinates with their proper sign as indicated below and perform the indicated operations, which are all algebraic, i.e., $s_1 = y_1 + y_{35}$, $d_1 = y_1 - y_{35}$, $s_{18} = y_{18}$, $d_o = y_o$, etc.

$y_o\ y_1\ y_2 \ldots\ldots\ldots\ldots\ldots\ldots y_{16}\ y_{17}\ y_{18}$
$y_{35}\ y_{34} \ldots\ldots\ldots\ldots\ldots\ldots y_{20}\ y_{19}$

Adding $s_1\ s_2 \ldots\ldots\ldots\ldots\ldots\ldots s_{16}\ s_{17}\ s_{18}$
Subtracting $d_o\ d_1\ d_2 \ldots\ldots\ldots\ldots\ldots\ldots d_{16}\ d_{17}$

$s_1' = s_1 + s_{11} - s_{13}$	$d_o' = d_o - d_{12}$
$s_2' = s_2 + s_{10} - s_{14}$	$d_1' = d_1 - d_{11} - d_{13}$
$s_3' = s_3 + s_9 - s_{15}$	$d_2' = d_2 - d_{10} - d_{14}$
$s_4' = s_4 + s_8 - s_{16}$	$d_3' = d_3 - d_9 - d_{15}$
$s_5' = s_5 + s_7 - s_{17}$	$d_4' = d_4 - d_8 - d_{16}$
$s_6' = s_6 - s_{18}$	$d_5' = d_5 - d_7 - d_{17}$
$s_1'' = s_1' + s_3' - s_5'$	$d_1'' = d_1' - d_3' - d_5'$
$s_2'' = s_2' - s_6'$	$d_o'' = d_o' - d_4'$

In using the table each sum or difference from above is to be multiplied by the sine of the angle indicated and written down in the table with its proper sign. Thus, S_1 in the table stands for the produce of $s_1 \times \sin 5$ deg. and d_{17} stands for $d_{17} \times 5$ deg., etc.

By means of this scheme the computations for any of the components can be omitted without introducing any error into the remaining components. For instance, if only the first five harmonics are desired the computations for all above the ninth may be omitted, decreasing the work by nearly half without decreasing the high accuracy of the harmonics obtained.

[8]Compare Fourier's "Series" and "Spherical Harmonics," by Byerly, p. 30.

[9]Thompson introduced the restriction of using a half wave from a zero ordinate to the next zero ordinate, which simplifies the scheme scarcely at all and the restriction sometimes becomes very inconvenient.

Central Station
Management, Policies and Commercial Methods

A LUMBER-ELECTRIC-LIGHTING-ICE PLANT.

Electricity and ice are the by-products of the power plant of a stave mill at Livermore, Ky., operated by the Smith Cooperage Company, of Louisville. The requirements of the stave plant are not sufficient to absorb all of the power produced, so that the company has installed an electric light plant, as well as machinery for making ice. It has recently filed an amendment to its charter providing that it may engage in the new business.

STREET LIGHTING AT PANA, ILL.

The Commercial Club of Pana, Ill., will ask the City Council to pass an ordinance to cause the removal of all poles and wires from the business streets to the alleys, the poles to be of uniform height and the service wires to be transferred from the street fronts of buildings to the rear. In addition, the club has subscribed for 50 five-lamp ornamental curb-lighting posts, to cost not exceeding $50 each. The lamps on these posts will be supplied from underground circuits. The city will furnish the energy and maintain the posts after the latter are installed.

GASOLINE COMPETITION.

The Salida (Col.) Electric Light, Power & Utility Company has replaced five gasoline-lighting systems by tungsten electric lamps in the past three months, only three gasoline systems now remaining in that city. As a result the insurance charges have been lessened. An unusual feature is that all wiring in connection with these new electrical installations has been done in conduit and metal molding. The total number of rewiring installations completed in the past three months is twenty-two, twenty of which were followed by reductions in fire-insurance rates.

CENTRAL-STATION SERVICE REPLACES LARGE INDIANAPOLIS ISOLATED PLANT.

The Merchants' Heat & Lighting Company of Indianapolis has taken over the supply of electrical energy and steam heat for the Century Building, a large local block occupied by publishers, manufacturers and other power users, which was formerly served by an isolated plant. Several years ago, when the Merchants' company was small and new to the Indianapolis field, it purchased a part of its electrical supply from this same isolated plant, to tide its customers' service over peak periods. With its present new 10,000-kw turbine plant on West Washington Street, however, the acquisition of the former isolated-plant load has made scarcely a ripple in the operation of the system.

GARAGE TO BE OPENED BY INDIANAPOLIS CENTRAL-STATION INTERESTS.

A garage capable of stabling 200 cars will be opened shortly at 320 North Delaware Street, Indianapolis, by the Merchants' Auto Company, whose president, Mr. E.

Darrow, is general manager of the Merchants' Heat & Light Company of Indianapolis. Harvey Stout, the latter company's attorney, will be general manager of the garage company, and Roy J. Wensley, formerly of the central station's engineering department, will be superintendent.

The new garage will stable and charge electric trucks and pleasure cars, making a specialty of the expert care and supervision of battery-driven vehicles, facilities for which have heretofore been lacking in Indianapolis, in spite of the large number of electric cars in use there.

A LARGE CENTRAL-STATION COTTON MILL FOR THE WEST.

Although cotton is the chief crop of most of the Southern and Southwestern States, and the principal market for the cotton goods is now in the West, all of this material must be twice shipped half way across the country to reach the mills which are along the Atlantic seaboard.

The long-hour demand of the cotton mill gives the business such an excellent load-factor that central-station managers in the West should not be slow to encourage the installation of cotton mills on their lines. Such business would be advantageous to the seller of electricity and profitable to the cotton-goods manufacturers, who would thus be enabled to save freight both ways.

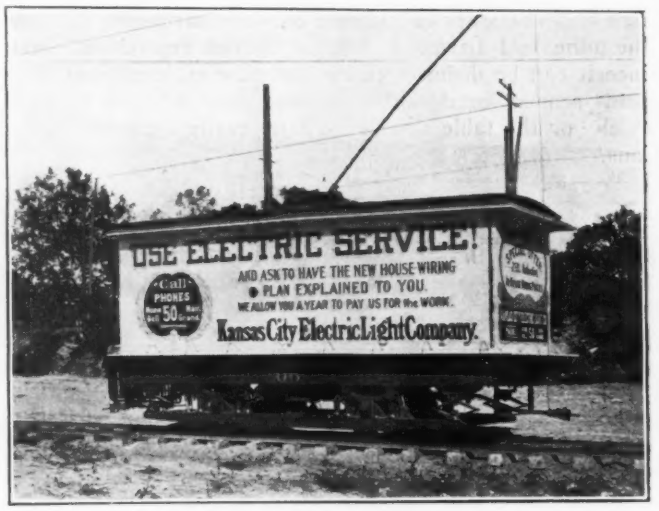
One of the first large cotton mills to grasp this economic situation is now being installed by the Kansas City Cotton Mills Company, at Kansas City, Mo. The mill will contain 50,000 spindles and will be driven by forty-three three-phase, 440-volt motors, aggregating 525 hp. Energy has been contracted for from the Kansas City Electric Light Company.

EXPANSION OF ELECTRIC POWER AT SALT LAKE CITY.

During the past three years the electric-power earnings of the Utah Light & Railway Company, of Salt Lake City, have increased at the rate of 35 per cent to 40 per cent per year. In June, 1909, the company's connected power load was 8738 hp; in August, 1910, this had increased to 13,600 hp, and at present the total rating of electric motors supplied with current from the company's system is 17,000 hp. Eight solicitors are at work in both lighting and power fields, two men being specially assigned to power applications to the exclusion of practically all other work. The company's commercial department was reorganized about three years ago and placed in immediate charge of Mr. B. W. Mendenhall as general agent. With the exception of steam auxiliary service, which is operated only during emergencies, all the output of the company is derived from hydroelectric stations of its own, supplemented by the purchase of about 3000 kw from the Telluride Power Company's system. The new steam plant at Jordan River, Salt Lake City, recently described in these columns, is now practically completed and is available for regular operation as a stand-by installation. Provision is being made in this plant for the control of the entire transmission and distribution system from a switching benchboard and remote-control oil-switch installation located on the premises.

ELECTRIC CAR PROVES SUCCESSFUL HOUSE-WIRING ADVERTISEMENT.

One of the most effective forms of advertising used by the Kansas City Electric Light Company during its present house-wiring campaign, according to Mr. C. F. Farley, contract agent, has been the equipment of a single-truck street car with signs, brilliant tungsten lighting and an electric piano, for operation after dark through streets in the sections where the house-wiring solicitors have been working. Since this car was put into service, two months


USE ELECTRIC SERVICE!
AND ASK TO HAVE THE NEW HOUSE WIRING
PLAN EXPLAINED TO YOU.
WE ALLOW YOU A YEAR TO PAY US FOR the WORK.
Kansas City Electric Light Company.
Call
PHONES
50

Electric Car Used for Advertising Purposes.

ago, the number of contracts coming in, it is declared, has been doubled.

Two sides and the rear of a single-truck car have been built up with light wood signboards framed by reflector troughs containing thirty 100-watt tungsten lamps. "Use Electric Service" and "Increase the Value of Your Home" are the catch phrases of the signs now used, the legend being changed from time to time at a cost of about $25. The signs are well painted in red and gold, on a white background, and the whole appearance is far from crude. In front the car is equipped with a powerful interurban type arc headlight and, to attract the attention of the ear as well as the eye, inside the cab is an equally powerful electric player piano. The movement of this phenomenon down a quiet residence street, with its headlight and many tungstens flashing and its piano playing, does not fail to attract its share of attention.

NEW SUBSTATION FOR KANSAS CITY ELECTRIC LIGHT COMPANY.

The Kansas City Electric Light Company has just completed the construction of its new Substation K, which was

Substation K of Kansas City Electric Light Company.

designed and built under the supervision of its regular engineering staff. This building, the exterior of which em-

bodies unusual architectural dignity and beauty, is of brick, steel and concrete and measures 133 ft. x 40 ft. in floor plan. It is located at Fortieth and State Streets and stands on the state line dividing Kansas City, Mo., from Kansas City, Kan., in the midst of a residential district.

The substation will house the frequency-changing and distributing equipment of the electric-light company, besides the first of several 100-kw rotary-converter sets of the street-railway company, which leases part of the substation building. Twenty-five-cycle, 6600-volt energy is received from the generating station and converted into 2300-volt, 60-cycle primary energy for lighting and 600-volt direct current for railway use. The bus structure in the basement is all of molded concrete and also serves as a pressure chamber for the air-blast transformers supplying the rotary converter. The station also contains space for constant-current transformers and rectifier sets. At the end of the building a spur track from the street railway is extended into the station, providing storage for a special work car if needed and also permitting heavy machinery to be brought inside on the cars, whence it can be picked up by the 25-ton, hand-controlled, motor-driven crane and deposited at any point in the station.

Mr. A. N. Richardson is general superintendent of the Kansas City Electric Light Company.

EXPRESS DELIVERY WITH ELECTRIC TRUCKS AT INDIANAPOLIS.

The Adams Express Company delivers from 60,000 to 80,000 packages monthly to addresses in its Indianapolis territory, using electric trucks exclusively after experience with both horse-drawn and gasoline vehicles. The 22 trucks of the company average 11,000 to 15,000 total miles in area traversed by both paved and unpaved streets. All of the trucks are equipped with the new Edison nickel-iron storage batteries.

The company maintains a modern garage in South Illinois Street, two squares from its express delivery depot. Charging plugs and storage space are provided for the nineteen one-ton and three-ton trucks. With the exception of two one-ton Landsen cars all of the trucks are of General Vehicle Company manufacture, 1906 model, the date of the first installation. At first the earlier type E Edison cells were used, but two years ago these were replaced by the type A cells, and after continuous use, according to Mr. A. F. Jones, local agent for the company, these cells give no visible evidence of depreciation. At the rear of the garage storage space there is a machine shop with lathe, drill, etc., and also a workroom where all minor repairs are made without recourse to outside help. Two day men and three night men are employed at the garage, a skilled electrician and machinist being included in the number.

All trucks are charged nightly, the cells being kept normally in fully-charged condition except for occasional and prearranged discharges once a week or so. Distilled water is added to the alkaline solution every second night, one of the two rows of cars being filled each evening. Once a month chains are washed in gasoline and boiled in graphite. Charging is done by ammeters on the switchboard, no instruments being provided on the trucks themselves.

The one-ton trucks in Indianapolis service make 12 to 35 miles per day, chiefly averaging runs of about 25 miles. The average used for daily charge is 17 kw-hours, including resistance losses in the charging panels. A careful record of the performance and cost of each truck is kept by the local office, an analysis of unit costs per day's run and per package delivered being made each month. In round figures, the cost of energy has averaged about 45 cents per truck per day, while the cost of supplies reaches 37 cents. Garage labor and expenses run about 75 cents per truck per day, and the drivers' wages divided by the total number of trucks, including one or two extra wagons, amount to $2 or more per day. For its truck operators the Adams company pays the same wage scale as is received by the drivers of the other companies' horse-drawn wagons, but gets the pick of the men since the electric vehicles are, of course, more pleasant to handle.

In general, the use of the electric trucks has proved a great economy of expense, time and trouble over horse or gasoline-truck delivery. The electrics can go further and faster, and can work more continuously than is possible for a horse-drawn wagon. The loads per trip are, of course, also heavier. The one-ton trucks sometimes start out with loads of 3000 to 3500 lb., and the larger wagons have carried five tons without apparent effort. Snow, ice and mud make no trouble for the Adams trucks, and during several days of the last winter these wagons continued on duty through 14 in. of snow and mud, while other local delivery services were suspended. A gasoline truck was in service at the Indianapolis Adams delivery for a time, but proved to be the cause of so much expense, time and trouble to keep it in operative repair that it had to be abandoned. But no qualifications are made concerning the success of electric trucks with nickel-iron batteries in the Indianapolis delivery service.

DECORATIVE LIGHTING IN SPRINGFIELD, ILL., DURING STATE FAIR.

The week of the annual State Fair at Springfield, Ill., is one of much business activity and great bustle and merriment. The electrical men of Springfield are not behind other business men in rising to the occasion. The Springfield Light, Heat & Power Company, of which Mr. Warren Partridge is general superintendent, supplied the electricity for the street lighting decorations illustrated herewith. For twenty-two blocks arches were erected over business streets and on some of the prominent corners there were intersecting arches as shown in Fig. 1. In each block five festoons of lamps were strung across the street. Each festoon consisted of twenty lamps. In addition there were longitudinal lines of lamps along each side of the streets containing fifty lamps to a block, so that the total number of lamps to the block was 200, or a total of 4400 in all. Eight-cp carbon lamps were used. Energy for this special lighting was supplied by the company's 220-volt direct-current mains.

Fig. 1—Decorative Lighting in Springfield, Ill., During State Fair.

Fig. 2 shows the special lighting of the court house. The dome of this building was outlined in 8-cp incandescent lamps and in all there were 800 lamps on the building. In the grounds surrounding the court house in connection with

the evening carnival there were installed fifteen arc lamps, fifty-one 16-cp lamps and thirty-six 32-cp lamps.

Although the State Fair itself was not open in the evening, a considerable use of electricity was made in the grounds. In the various buildings and around the fair

Fig. 2—Decorative Lighting of Court House at Springfield, Ill.

grounds there were placed eighty-four arc lamps. These were carried on constant-current tub transformers located on the grounds and fed from 2300-volt single-phase alternating-current circuits. In addition, the State Fair authorities maintain a permanent equipment of their own and from this source were supplied thirteen flaming-arc lamps in the Dome Building, six flaming arcs in the Exposition Building and five flaming arcs in the Coliseum. In addition to the arc lighting, there were about 800 16-cp lamps used for miscellaneous building lighting at the State Fair grounds. A number of the private exhibitors used electric lighting decorations and this service demanded about 1000 16-cp lamps, thirty arc lamps and about 50 hp in motors.

OPERATING ELECTRIC VEHICLES ON A BASIS OF SPECIFIC-GRAVITY RECORDS.

To encourage the proper and satisfactory use of electric vehicles by its customers, the Commonwealth Edison Company, Chicago, has mailed out to its private garage consumers blank record forms, one of which is reproduced herewith.

An interesting feature of this card, which includes columns for setting down the hours and rate of charging, energy consumption, specific gravity, miles run, etc., is the entire absence of any space for recording the voltmeter readings at the beginning and end of the charging operation, although in the past the battery voltage has generally been considered one of the most important elements of the cells' history and has usually been the principal factor in governing their charge and discharge.

As is well known, however, the voltage indicated by a battery is at best only inferential of the energy yet remaining in the plates, and although this method is generally used as a convenient index to indicate the condition of the cells many cases of battery abuse are on record whose cause can be traced to the fact that voltmeter readings alone were relied on by inexperienced persons for indication of when to cease charging. In other cases, where complaints have been made by garage owners that their charging costs were running unduly heavy, the Commonwealth company has dispatched its battery experts to the spot only to discover that in the effort to bring a given battery up to its prescribed end-of-charge voltage the attendant was putting about twice as many kw-hours into the cells as they properly needed—not only wasting energy and casting unfair reflections on the cost of running the car, but also working damage to the plates.

The real index to the condition of charge in a battery is, of course, the specific gravity of the sulphuric-acid electrolyte. As the cell is discharged the specific gravity falls, ranging from 1.280 in a fully charged condition down to 1.160 when the cells are about exhausted. It is by this

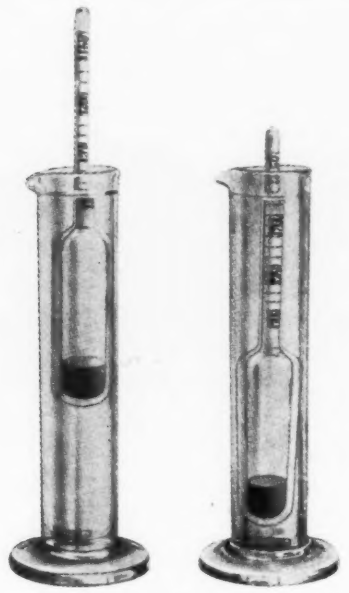


Fig. 1—Hydrometers in Electrolytes from Fully Charged and Discharged Batteries.

record of specific gravity that the Commonwealth company is now urging its customers to be governed, along with records of the kw-hour input into their batteries and the miles of car travel. The proper time for starting and stopping the charge is definitely fixed by the reading of the hydrometer, and to show the simplicity and convenience of using this instrument in electrolyte withdrawn from one of the cells by means of a syringe the company illustrates

Compliments of

COMMONWEALTH EDISON COMPANY

~~130 Adams Street,~~ Telephone Randolph 1280 Chicago, Ill.
120 West Adams Street,

Electric Vehicle Battery Record of_____

Address_____

Make of Vehicle_____ No. of Cells_____

DATE	START TIME	START AMP'S	FINISH TIME	FINISH AMP'S	START WATT METER READING	FINISH WATT METER READING	KILO-WATT HOURS	GRAVITY START	GRAVITY FINISH	AMP-HOUR METER DISCH.	AMP-HOUR METER CHARGE	MILES RUN	REMARKS ODOMETER
AUGUST, 1911 1												12	1911
2								1240				20	1932
3					9700	10292	0592	1300	1280			18	1950
4								1240				39	1990
5					10292	10795	0503	1280	1260				
6													
7												16	2006
8								1230				21	2027
9					10795	11420	0625		1260			9	2036
10												19	2055
11								1240				14	2069
12					11420	11956	0536	1300	1280			23	2092
29					14909	15509	600		1280			18	2422
30								1260				14	2436
31								1220				16	2453
Total							108	KW-HOURS				542	MILES

ADDITIONAL COPIES OF THIS CHART WILL BE MAILED UPON REQUEST

Fig. 2—Electric-Vehicle-Battery Record.

full size in its electric vehicle hand-book hydrometers in fully charged and discharged solutions.

For any given car a definite relation can thus be worked out for the number of amp-hours or miles' travel in a battery in terms of its specific gravity of electrolyte. For

example, a certain pleasure car which will run 72 miles on good streets when charged to a density of 1.280 can be positively relied upon to go 60 miles when the gravity has fallen to 1.260, 42 miles at 1.240, 36 miles at 1.220, 24 miles at 1.200 and 12 miles at 1.180, becoming fully exhausted at 1.160.

In suggesting the use of its new record cards, the Commonwealth company, according to Mr. Roderick Macrae, of its electric vehicle department, does not urge that all of the columns provided necessarily be filled. Even the time of starting and finishing the charge, together with the current rates in amperes, may be omitted, as in the accompanying specimen card. As most cars are not provided with amp-hour meters, the columns relating to electricity input and output must also be dispensed with in the majority of cases. The really important data to be recorded, however, are the energy input, the specific gravity at the end and beginning of the charge, and the number of miles accomplished.

The card in the illustration gives the record of a pleasure vehicle operated entirely with respect to the specific gravity of its battery, the latter's condition having determined the necessity for giving a charge or cutting off a charge under way. During the month of August, for which the record shows figures, this car ran 542 miles, at a total switchboard consumption of 108 kw-hours. This performance, 5 miles per kw-hour, is considered a good average for a car of this kind. As the rate for battery-charging energy under the Commonwealth Edison Company's schedule varies from 7 cents to as low as 3 cents per kw-hour, it becomes evident that the operation of an electric automobile is in no sense the expensive luxury prospective customers sometimes fear.

Wiring and Illumination

CENTRAL-STATION OFFICE-BUILDING ILLUMINATION.

One of the central-station companies that utilize decorative lighting for the purpose of advertising both the location of their offices and the brilliance of electric light is the Union Electric Light & Power Company, of St. Louis. This company removed its general offices a short time ago to a building on the corner of Twelfth and Locust Streets, and the accompanying photograph represents the appearance of this building at night. It will be noticed that the building is made prominent by outline lighting consisting of lines of incandescent lamps. In addition there are two electric signs bearing the words, "Union Electric," one a roof sign and the other a vertical sign slightly projecting on the other side of the building. A conspicuous feature of the spectacular illumination of this building is a row of ten flaming-arc lamps which are suspended on the level of the second floor of the building. A portion of the building made so conspicuous is utilized as a theater, and there is an electric sign for this theater and also a row of incandescent lamps around the sidewalk canopy at the theater entrance. The fact that the building is visited by large numbers of theatergoers at night makes the electric-light advertising of the Union Electric Light & Power Company particularly valuable.

Illumination of Office of Union Electric Company, St. Louis.

BACKYARD CONCRETE POLE LINES FOR SUBURBAN DISTRICTS.

The substitution of backyard pole lines for pole lines on the streets, although not very widely adopted, is still not unknown to central-station men, descriptions of some of the systems, notably that in Brooklyn and also that in Rochester, having appeared in these columns. In theory, at least, the backyard system does not differ materially from the alley system used in those cities possessing alleys between streets, in that it serves to keep poles from disfiguring the front views of houses and from interfering with the natural growth of trees. The system also possesses an added advantage when properly installed in that it wards off the danger of a public clamor for underground conduit in sections where the expense would be out of all propor-

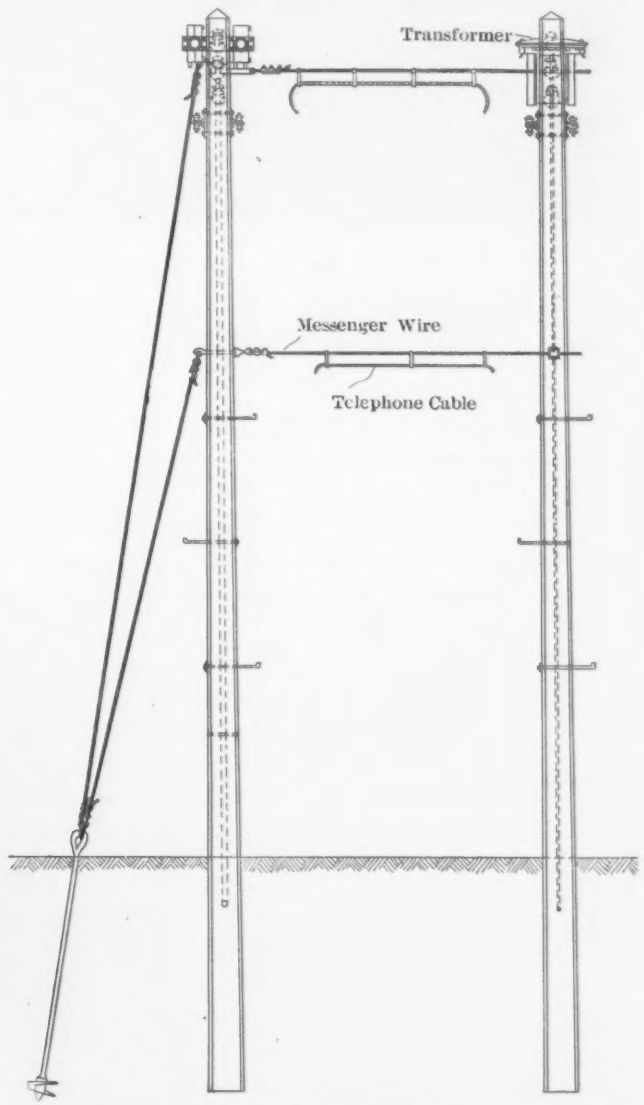


Fig. 1—Details of Terminal and Intermediate Concrete Poles.

tion to the income possible from the connected load existing or liable to exist for a great while to come. In suburban sections graced with expensive dwellings and well-kept grounds a pole line, no matter how well installed, is sure

Fig. 1—Intermediate Concrete Pole in Backyard.

to jar the sensibilities of some of the residents, and in such localities very little difficulty should be experienced in obtaining a right-of-way through backyards for lighting and telephone circuits.

The illustrations presented herewith show a high-grade

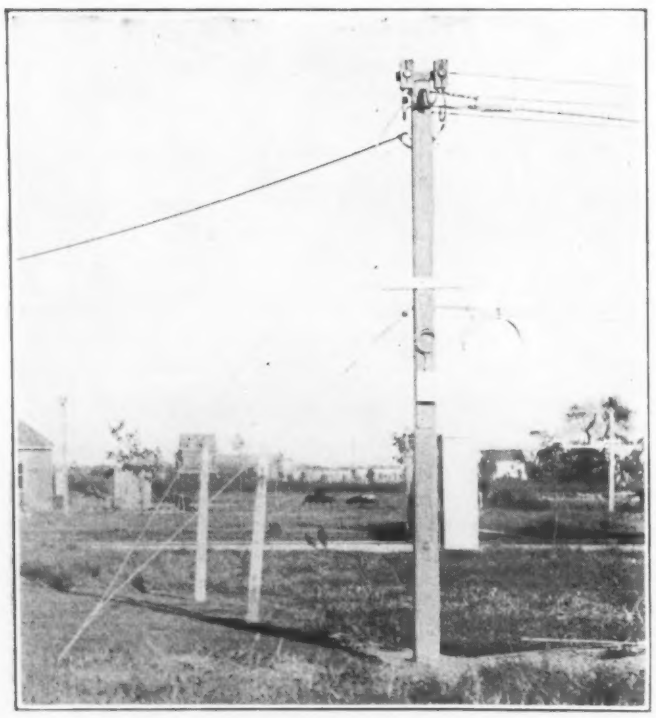


Fig. 2—Intermediate Concrete Pole.

backyard system in the Borough of Brooklyn installed by the Edison Electric Illuminating Company, of that city, and used jointly by it and the Bell Telephone Company. The detail construction of both the terminal and the intermediate concrete poles is shown in Fig. 2. The poles are made in the Parkville yard of the company and specially made cast-iron templates are employed for the molds. Each pole is 23 ft. high and sits from 5 ft. to 6 ft. in the ground. At the base of the terminal pole there is a box from which the primary underground cable is drawn through 1½-in. iron pipe through the center of the concrete pole and out at the top through the primary fuse boxes to the next pole on messenger wire. The primary cable is connected to a transformer at the next pole and a secondary is then run on brackets to the various customers.

At about 7 ft. from the top of the pole eye bolts are installed on which the messenger wire that supports the telephone cable is fastened. Through the center of the intermediate poles there is a ⅜-in. iron pipe through which the ground wires of the transformer and the cable armor are run. There are also installed near the tops of the intermediate poles two Philadelphia brackets which act as pull-offs for the service cable. The sketch shows the poles equipped with steps for climbing; but the latest practice of the company is to do away with these as shown in the photographs, as it has been found to be more convenient to work from ladders. The Edison Electric Illuminating Company is experimenting with concrete poles, but the ones here described have been very successfully used and are made of a mixture of three parts clean sand, five parts broken stone and one part cement. The mixture is poured rather wet and ¾-in. ridge bar is employed for reinforcement. The poles shown have a base about 9 in. square and a top 6 in. square, the corners being chamfered.

RECENT TELEPHONE PATENTS.

PARTY-LINE SYSTEM.

One of the well-recognized types of selective party line is that employing a sectional line which is built up from station to station until the desired one is reached.

Such systems have heretofore required that at least one side of the line be looped into each station and where some of the stations are off the general direction of the line considerable extra wire is required in looping in and out. It is with the idea of obviating this expense that Mr. S. A. Souther, of Chicago, has produced the system for which a patent has been granted him. According to his plan the main line and branch lines are arranged as though separate lines, and the branch lines are bridged to the main line through the contacts of a relay. The relay has its winding included in the sectional side of the main line beyond the point of attachment of the corresponding branch. The stations on the branches are arranged in the series as though farther out than the last main-line station and the nearer branches are later than those farther out. Whenever any relay is pulled up its corresponding branch is cut off; therefore, whenever a branch line has been passed, the branch is cut off each time current is sent out to build up sections beyond it. When the last main-line station is passed the end of this line is left open and the outermost branch relay fails to respond to current impulses, which now become effective to build up the branch from station to station to the desired one or to an open end. If the latter, the stations of the next branch begin to respond, etc. The Homer Roberts Telephone Company has been assigned this patent.

SWITCHBOARD CIRCUIT SYSTEM.

In systems where there is a line relay to close the calling-lamp circuit and a cut-off relay to put out this lamp, the cut-off relay usually removes the line-relay coil from circuit. However, because of its inductance, the coil of the line relay is likely to generate a very decided and disagreeable click. This is overcome in the arrangement of circuit invented and patented by Mr. C. S. Win-

ston, of Chicago, in his recent patent. He cuts off the lamp circuit only, the operating winding of the line relay being left in the line but inductively neutralized by a second opposing winding, which is closed through front contacts of the cut-off relay. This patent is assigned to the Kellogg Switchboard & Supply Company.

SUBSCRIBER STATION DEVICES.

Mr. R. E. Southwick, of Los Angeles, has invented a desk stand in which all the apparatus of the set is mounted. The induction coil and condenser are mounted in the base. A false cover to the base or to the transmitter serves as a gong and the ringer is mounted in such position that its clapper strikes this cover.

Mr. C. W. McKibben, of Beaumont, Tex., has arranged a circuit for use on high impedance lines where a high-powered transmitter is used. An adjustable coil is in series with the receiver, but shunted through a switch. When talking the switch is opened, the shunt removed and the side tone is thus cut down.

An auxiliary ear-piece attachment forms the subject of the patent issued to Mr. C. H. Gatchell, of Boston. The ear-piece with a flexible sound-conducting tube for the second ear is mounted upon a flat plate. The plate clamps upon the receiver ear-cap with the end of the auxiliary sound passage registering with the sound aperture in the receiver cap. The idea is to produce an apparatus to conduct received sound to both ears, which may be applied without removing the regular receiver cap.

AUTOMATIC-MANUAL TRUNKING.

Automatic systems require the maintenance of special conditions in the circuit for an appreciable length of time in order to clear a connection. Where a manual switchboard and automatic are connected together it is advisable to establish the disconnect condition automatically at the completion of a call in order not to delay the operator nor have any one hung up. The accomplishing of this is the object of an invention of Mr. A. R. Kahl, of Rochester, N. Y. He arranges a slow-acting circuit in order to obtain the time interval. This is done by retarding the de-energization of the circuit-control relay by the use of reactances and by connecting two or more relays in series so that one must fall back to release another, the last releasing the control circuit. This patent is assigned to the Stromberg-Carlson Company.

Letters to the Editor.

Rating Motors in Kilowatts.

To the Editor of Electrical World:

Sir:—I have noted with great interest the fact that the International Electrical Technical Commission at its Turin meeting adopted the proposals of the Brussels conference, whereby the output of electric motors is defined as the mechanical power at the shafts, and is to be expressed in international watts. It is with mingled feelings of pleasure and doubt that I revolve this proposal in my mind, inasmuch as I was responsible for carrying exactly this scheme into practice now nearly twenty years ago. It had been suggested by the International Congress of 1884 as a natural and suitable rating for motors, inasmuch as the kilowatt is just as good a mechanical unit in principle as the horse-power and has the very considerable advantage of being definitely related to the absolute system, forming, in fact, the connecting link between the mechanical and electrical branches of that system. At that time, however, kilowatts were not as familiar as they are now, and I am not aware that anything practical was done in the way of carrying the suggestion into effect until 1893. At that time I was directing the building of the first three-phase generators and induction motors turned out by the General Electric Company at its Lynn works, and decided that inasmuch as the kilowatt rating for motors was a perfectly logical one and we then had the opportunity of using it on a totally new piece of apparatus in no way tied up by precedents in motor practice, it would be an opportune time to break away from the horse-power and get the rating on to a proper scientific basis. So we tried it with the first line of commercial three-phase motors, including machines of 1-kw, 3-kw, 5-kw, 10-kw and 15-kw mechanical output. If I mistake not, a few of these early motors are running yet, bearing the kilowatt rating on the name plate.

I am bound to say, however, that this well-intended innovation did not seem to fill any long-felt want, and it was soon found wise to abandon it. The trouble came from the fervid protest of the commercial organization. In the first place it was justly charged that the ordinary customer for motors had very little notion as to what kilowatt output meant, and could not be easily persuaded that this was not a new form of bunco game. Second, the kilowatt rating was, of course, numerically smaller than the horse-power rating of the same machine, and the man on the street not unnaturally thought of the machine in horse-power rather than in kilowatts. In those days, when it was no easy matter to sell three-phase motors in the face of the direct-current competition at best, the handicap of a totally unfamiliar rating was a thing not to be taken lightly, nor, indeed, is the argument against a change to a new unit giving a smaller numerical designation one that is entirely without force even to-day. I have a very strong suspicion that if the hefner were bigger than the international candle, instead of smaller, it would be less tenaciously held as a practical unit of light.

Kilowatts are so familiar at the present time to the ordinary public that I fancy an attempt to carry out the resolution of the Turin conference will be more successful than it was nearly twenty years ago. It is certainly a desirable change to make, because the horse-power is at best an empirical quantity derived from ancient and by no means reliable experiments, and moreover, the French *cheval-à-vapeur* is not quite the same as the English horse-power, so that the passage to a definite international unit founded on the scientific system of measurements ought to have a good chance of practical success. It will be particularly desirable as enforcing once for all the use of the watt as both an electrical and a mechanical unit, which, particularly from the standpoint of the student, is a highly desirable thing. Let it here be written, however, that in 1893 the General Electric Company gave the plan a fair trial and only abandoned it for commercial reasons, which it is to be hoped will be found less pressing now than then.

Boston, Mass. Louis Bell.

Automatic Block Signals for Electric Railways.

To the Editor of Electrical World:

Sir:—A paragraph appeared in your issue of Sept. 23 under the above heading which says: "At a recent meeting of the Illinois Electric Railway Association Mr. H. E. Chubbuck, of the Illinois Traction System, called attention to the remarkably few failures of the automatic block signals on that system. During August, with ninety-four signals installed, making 143,904 movements, there were but thirty-eight failures; signal operation was 99.97 per cent perfect."

Before commenting on the above excellent, but somewhat misleading, statement permit me to call attention to a few well-established historical facts on this subject, from an original source, which may be of interest and are probably new to many of your readers.

The writer originated the closed-rail circuit system of automatic electric signaling and received basic patents covering the same in the United States and France in 1872, and in that year I installed the system, putting it in practical operation under trains in a closed-rail circuit block about a mile in length on the Philadelphia & Erie Railroad, thus demonstrating its operativeness and utility. I was the sole owner of this system for eight or nine years after inventing, patenting and demonstrating the same. During this time I made many installations on various railroads in different States, embodying block signaling, including overlapping, front and rear, and station-approach signaling, also including drawbridge and switch connections and operations, in one instance connecting six switches in a single block, the derangement of any one of which would instantly show the danger block signal. In short, in the early seventies I had developed and perfected the system, including rail bonding, so that it performed every function which it performs to-day, and as perfectly and reliably. In fact, in those early days I established, by experiment and continuous use, basic data that are now used, such as resistance, wire gage and strength of current necessary to get best results.

It may be of interest, also, to note that about 1880 or 1881 Mr. George Westinghouse and his associates acquired control of the Robinson basic signal patents and interests by purchase, and immediately reorganized under the name of the Union Switch & Signal Company, which thereafter had the sole control of this system until the expiration of the Robinson patents, when it became public property. It may be here added that the company which Robinson organized and originally owned for the exploitation of his signal system was called the Union Electric Signal Company, and in the reorganization under the name of the Union Switch & Signal Company the terms "Union" and "Signal"' were derived from the Robinson company.

Perhaps the most important and interesting point, however, to which I wish to here call attention is that during the whole time I owned and controlled this system I never knew of a single instance of the signals failing to operate exactly as originally intended; and of the tens of thousands of these automatic block signals installed since then, I have never known of a single authentic instance of one of them failing to operate precisely as it was originally designed to operate.

In this connection it may be pointed out that the one radically unique and most important feature of this closed-rail circuit system, not found in any other system before or since its inception, is that every signal not only performs its normal functions for the automatic control of trains, but it also acts as an absolute check upon its own operation. Thus, if by any means its source of current supply is interrupted, mechanically or otherwise, the signal instantly goes to danger for lack of operative current, thus indicating its own derangement through some cause outside of itself. This, of course, is not a failure, but one of the chief and distinguishing excellences of the system. It blocks trains instantly which otherwise might meet with collisions and wrecks and incalculable loss of life and property, as would inevitably be the case in the New York subway, for instance.

To illustrate, a year or two ago, just after a torrential rainstorm, every signal on both tracks in the New York subway between the New York City Hall and Borough Hall in Brooklyn went to danger, stopping every train between these points. The general manager of the Interborough Railway Company, operating the subway, was quoted as explaining the immense blockade of the subway resulting by saying that it was owing to the failure of the signals. Investigation, however, showed that the trunk-line conductors feeding the signal system were carried from the power house in Brooklyn to the subway through an unsealed or improperly protected conduit, and the heavy rain flooded the conduit, thus cutting off operative current from the signals. Thus each individual signal between the points named, in the adjacent boroughs, pointed out with unerring certainty not only the exact location of the trouble but the responsibility for the blunder or negligence which caused this unnecessary blockade. Could signal efficiency be greater than this?

In this connection it may be pointed out that without this automatic signal system it is more than doubtful if the New York subway could transport in safety 20 per cent of its present enormous passenger traffic.

As already indicated, some people carelessly speak of the signals as "failing" when, as a matter of fact, they are working perfectly and unerringly pointing to the fact that somebody has neglected his duty or something has occurred entirely outside of the signals to arrest, temporarily, their operative functions, thus giving specific notice that while responsible for their own perfect action they decline all responsibility for outside errors or actions by others over whom they have no control, but who, so far as the working signal system is concerned, are mere unwelcome interlopers.

Mr. Chubbuck explains the cause of the thirty-eight alleged failures of the signals in 143,904 movements of ninety-four signals on his road in August as follows: Twenty-four were caused by electrical storms which burned out fuses and in two cases broke the line wires; nine so-called failures were due to shutting off the supply of electrical energy in the transmission system; two were caused by grounded lightning arresters, and three were due to other causes. Thus, in this case, the so-called 99.97 per cent perfect clearly becomes 100 per cent perfect. And this, in the last analysis, is the percentage of perfect working which this system has attained and maintained constantly during more than the last thirty-five years.

For the benefit of those specially interested, I add the following references to sources of information on the development of railway electric signaling: Robinson's basic patents on electric signaling: United States, No. 130,661, Aug. 20, 1872; closed rail circuit. British, No. 2,280, Aug. 30, 1871; aut. electro-pneumatic; now in general use; also covers electro-mechanical. French, No. 94,993, Feb. 29, 1872; covers closed circuit and subject matter of the British patent. Third annual report of the Block Signal and Train-Control Board, dated Nov. 22, 1910, pages 177 and 178. Court decisions: Union Switch & Signal Company vs. Reading R. R. Company and the Hall Signal Company, 96 F. R., 761; 37 C. C. A., 580.

Brooklyn, N. Y. Wm. Robinson.

The Small State Electrical Association.

To the Editor of Electrical World:

Sir:—At the usual small state electrical or public utility convention the program is a dull and prosy thing, discussion largely or wholly lacking, and the meetings a bore. In many such organizations the duty of preparing and delivering papers falls too often on those who are simply accessible or willing, rather than on the men who are best qualified to treat the subjects discussed. Some members, when called upon for such papers, overlook the brief and pertinent points with which they might benefit their fellows and, instead, involve themselves in an unequal struggle to comprehend the whole development of their subjects from the dawn of Eocene life to the future promised perfection of the art. At a recent state convention a paper on the organization of a power plant staff started from the Declaration of 1776, reverted to the discovery of cuneiform characters on building brick, discovered Faraday's experiments in induction, discussed absolute thermal efficiency and entropy, and thus continued in solemn En-

lish through nearly forty pages of closely typewritten matter. The convention was held at a summer resort, the paper was brought up twice at the regular meetings and read each time for a spell by a heroic secretary, while the tortured members fidgeted or drowsed and then, finally, half-read, it was voted over to the limbo of unfinished business. Almost every small convention in which the officers are inexperienced in handling association matters can show several examples of such long academic papers, so full of the well known and the platitudinous as to conceal effectually whatever points of originality they contain. After thus exhausting the patience of the audience it is little wonder that such papers provoke no lively discussion—the feature that should be the most valuable part of the sessions. For, instead of discussion by those really qualified to give new angles and viewpoints of the subject, the air of the convention, after such a long-drawn effort, is so surcharged with the frantic idea of going on with the next paper in order not to fall behind the already belated schedule that anyone who even risks asking a question is met with frowns of impatience.

The means of improving these conditions in the small conventions is not difficult, for the present dissatisfaction has sprung rather from the failure of presidents and secretaries to see to it that those on the program know what is expected of them. One solution is to limit the papers to a length that can be presented in ten or fifteen minutes. Another, and perhaps the better, would be to give the authors free rein in their preparation of papers to be printed in the society's *Transactions*, but limit them to a five or seven-minute discussion of the principal points brought out. The papers should invariably be printed in advance and distributed among the members, or at least enough of those known to be especially interested in the subject, to enable them to discuss it with proper information. With seven minutes allowed for the author's review of the main points and twenty-three more set aside for the real vital discussion by those interested, whose patience would not be taxed as at present, the meetings would become interesting and the usual conditions of slack attendance would improve. The average convention is held at a good deal of expense to the interests which support it, and certainly those in attendance should profit to the fullest amount possible.

Discussion and informal meeting among themselves, central-station men will certainly admit, are worth far more to them than the printed program. Too few operators in the same state and near-by towns know each other by sight or name, although they may have many common business and technical problems in which mutual advice would be of the greatest value. The increasing use of label badges helps to acquaint members of the convention with each other, but during the discussions and other business, as each man rises to speak, he should be required to give his name and town, or if these are known to the presiding officer the latter should acknowledge his taking the floor with a clear enunciation so that every member can hear. The value and interest of the discussion are greatly increased when the identity of the speaker is known.

In the running of such a state association there can be no doubt that the most important official is the secretary. The position of president is chiefly honorary and ever-changing in these organizations. But the secretary is properly a permanent officer whose work on behalf of the society is done throughout the year and whose preparation of the programs can make or mar the meeting as later carried out. In the choice of a secretary the greatest care should be exerted. The experience of the most successful state associations shows that the secretary should himself be a central-station man of personal force, as well as familiar with plant subjects and the operators of his state. Such a secretary can grasp the real needs of the body and industry, put on foot and carry out valuable special inquiries, investigations, etc., and also attract prospective members into the body. To compensate such a man for time and attention distracted from his regular business, he should be voted an attractive salary from the association treasury, and experience has shown that this payment is one of the best investments that the small association can make.

Cincinnati, Ohio. CHARLES L. MORGAN.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Synchronous and Non-Synchronous Reactance.—J. REZELMAN.—The first part of a highly mathematical article. The action of the rotor of a synchronous alternator with respect to the stator is in part of a polyphase nature. The article deals with the reactance under various conditions of speed, etc., of the various possible combinations of single-phase and polyphase stators and rotors; the polyphase stator with single-phase rotor is in particular interesting. Only machines with non-salient poles are considered.—London *Electrician*, Sept. 29.

Induction Motors.—A note on a recent British patent (25,683, Sept. 21, 1911) of the British Thomson-Houston Company and J. Martin. To increase the range of speed variation the stator is provided with a three-phase winding which can be connected for two or four poles. The rotor is fitted with a six-phase winding and can operate as a single winding for one number of poles or as two distinct three-phase windings for double the number of poles. The speed of the motor is controlled by a six-phase star resistance connected to the slip rings.—Lond. *Elec. Eng'ing* Sept. 28.

Lamps and Lighting.

Metallic-Filament Lamp Tests.—A. TURPAIN AND H. NICOLEAN.—The authors formerly made an extensive series of tests of various types of metallic-filament lamps in order to select the best lamp for the municipal service of the city of Poitiers in France. They selected the osram lamp in 1909, and this has since proved very satisfactory. Thus in a hotel in Poitiers the yearly lighting cost was reduced from $187 in 1908 to $119 in 1910, the latter price including the purchase price of new lamps ($34); at a school in Poitiers the lighting cost was reduced from $135 in 1908 to $75 in 1910. In both cases the number of lamps was greater in 1910 than in 1908. The authors have again made an extended series of modern metallic-filament lamps, and they give the results in tables and diagrams. They tested with direct current the following lamps: Osram, canello, Z, osmine and alphalia, and with alternating current the following lamps: Osram, canello, osmine and alphalia. The most noteworthy result is the reduced life with alternating current, as compared with direct current; only the 50-cp osram lamps and the 25-cp alphalia lamps had a life of over 1000 hours (the osram over 2000 hours). This result is attributed by the authors to the considerable voltage fluctuations of the alternating-current system of Poitiers, due to the many motors supplied with energy from this network.

Furthermore, there are the vibrations of the filaments.

due to the alternations, which can be observed with the naked eye. In spite of the shortened life the employment of metallic-filament lamps is very economical even with alternating current.—*La Revue Elec.*, Aug. 25.

Technical Spectro-Photometer.—J. Thovert.—The author described at the recent meeting of the International

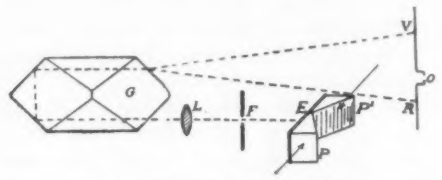


Fig. 1—Spectro-Photometer.

Photometric Commission in Zurich a simple arrangement by which an ordinary photometer can be used to measure relative intensities in the different colors of the spectrum. As shown in Fig. 1, the prisms *P* and *P'* reflect the light from the two sources to be compared on to the photometer screen *E*. Between this screen and the eye-piece are placed a slot *F*, an objective *L* and a pentahedric prism *G*. The image of the slot *F*, in which the two illuminations are seen side by side, is dispersed by its passage through the prism, so that it is spread over the whole width *VR*. The eyepiece *O* can be shifted through the whole range of color from *V* to *R*, and any particular color can be measured according to its position. The field is observed as two adjacent zones, the brightness of which can be made equal by moving the photometer between the sources of light in the usual way. Owing to the low values of illumination obtained it becomes difficult to make observations with wave-lengths of less than 0.5 μ.—*The Illumin. Eng.* (London), September.

Light Production.—R. A. Houston.—In a continuation of his long serial on "studies in light production" the author deals with the Welsbach mantle and selective radiation.—London *Electrician*, Sept. 29.

Generation, Transmission and Distribution.

French Hydroelectric Stations.—The number of hydroelectric stations in the four large river districts in France is as follows:

District of Seine River	149	plants
District of Loire River	114	"
District of Rhone River	343	"
District of Garonne River	251	"
Total	857	plants

H. Bresson gives statistical tables on the history, ownership and engineering equipment of the 149 plants of the Seine district. J. Boulanger gives sketches, with maps, of the distribution of energy in the Côte-d'Or and of the transmission and distribution systems of the Grosne Electric Company.—*La Revue Elec.*, Aug. 25.

High-Pressure Steam Pipes.—J. Guillaume and A. Turin.—The first parts of a long article, profusely illustrated by diagrams and tables, giving practical notes and data for the design of high-pressure steam lines.—*La Revue Elec.*, Aug. 11 and 25, Sept. 8.

Traction.

Public Service Railway of New Jersey.—A very full, detailed article, covering eighty-four full pages of text and profusely and beautifully illustrated by forty-eight full-page plates, besides illustrations in the text. After a general introduction special chapters are devoted to the corporation and its organization; office buildings; way department; energy generation (the total output in 1910 of the generating stations being 288,740,147 kw-hours, of which the railway company used 150,108,893 kw-hours, and the remainder, or 138,631,254 kw-hours, was used for lighting and motor service); overhead construction; rolling stock; maintenance of car equipment; transportation department; purchase and storeroom departments; accounting department; claims department.—Convention Number *Electric Railway Journal*, Oct. 7.

Electric Locomotives for Shunting Purposes.—A. H. Marshall.—A paper read before the Cleveland Institution of Engineers. Shunting is taken to include: (1) The handling of heavy goods and mineral traffic in yards and sidings, as now done by steam locomotives; (2) the haulage of minerals below ground, as now done by stationary engines and horses, with particular reference to Cleveland iron-stone mines. Although shunting covers a wide field the following specifications for an electric system are thought to meet all demands: System direct-current, 550 volts, negative side earthed, track rails as negative conductor; one, two or four series-wound motors per locomotive; series-parallel control work with resistances. Except in some special cases (in mines) the locomotives can best be supplied with energy by means of overhead conductors. Compared with the steam locomotive the electric locomotive has the following advantages: It loses no time on the road, coaling, watering, etc.; it accelerates more quickly; it requires no shed for boiler cleaning, etc.; it needs fewer repairs and renewals. The steam-engine designer is confronted with a serious problem when he has to produce an engine of more than about 26 tons. In the electric locomotive each axle is independently driven and sizes up to 60 tons can be built with a rigid wheel-base not exceeding 6 ft., the whole of the engine weight being available for adhesion. Figures are given for the actual cost per ton-mile with steam-operated shunting locomotives and for the estimated saving with electric operation. Perhaps the most striking fact brought out in the paper is the indication it gives of the very small amount of useful work performed by steam engines in shunting operations. For instance, in the case of the Newport works the equivalent of the full amount of useful work done by the seven steam locomotives during the busiest twenty-four hours of the week, including that required to move themselves about, can be given out by any one of the comparatively small generators (1.250 kw) at the waste-heat power stations at these same works in twenty minutes. In addition to the saving on fuel there is a further large saving on locomotive repairs and renewals. As regards the ease of operation and simplicity, too much cannot be said in favor of the electrical machine. A further advantage of the electric locomotive is that the driver has a clear view of his work fore and aft, and thus can more readily avoid collision, and, what is more important, accident to workmen. At night, too, very much more work can be done by the aid of the powerful headlamps with which each engine is fitted, while the dangers incidental to shunting operations are reduced. There is also something to be gained by reducing the output of smoke and steam in busy yards and thickly populated districts. Some notes are added on installations in mines where special conditions may necessitate special provisions.—London *Electrician*, Sept. 29.

Volt-Hour Meters for Tramways.—A volt-hour meter is mentioned in a paper by R. G. and J. G. Cunliffe before the (British) Municipal Tramways Association. The new meter is in principle a direct-current motor in its simplest form, having a moving armature of a special and simple design, and it is designed so that the speed of the armature is proportional to the voltage. The meter is arranged to read in volt-hours; thus, at the end of one hour the average voltage of the circuit during that hour is indicated directly on the dial. Special applications of this meter are on those tramway sections where it is desired to keep a constant check of the average voltage, and in connection with tramway systems using ampere-hour meters on the cars, which when used alone may give misleading results. The new meter has neither pen nor paper; it can be used either in a stationary position or upon a car and has the advantage

of recording directly upon a dial.—London *Electrician,* Sept. 29.

Swiss Single-Phase Road.—S. Q. HAYES.—An illustrated description of a narrow-gage, single-phase road connecting Locarno, on Lake Maggiore, with Pontebrella and Bignasco, in the Valle Maggia of Switzerland. The operating emf is 5000 volts, except in Locarno, where 800 volts is used. Each truck has two 40-hp single-phase series motors.—*Elec. Journal,* September.

Wires, Wiring and Conduits.

Electric Conductivity of Commercial Copper.—F. A. WOLFF AND J. H. DELLINGER.—The authors review the various standard values in use for the resistivity and temperature-resistance coefficient of copper and describe the means of making precise measurements of the conductivity of wire samples. The resistivities are given for eighty-nine samples of commercial copper from fourteen important refiners and wire manufacturers in this and other countries. The mean for annealed wire is: Resistivity in ohms per meter-gram at 20 deg. C. = 0.15292; per cent conductivity = 100.07. (Per cent conductivity is computed on the basis of 100 per cent conductivity corresponding to the standard resistivity, 0.153022 ohm per meter-gram at 20 deg. C.). The mean result of data furnished by a large wire manufacturing company, representing tests on more than 100,000,000 lb. of copper, is also given; for example, for annealed samples: Resistivity in ohms per meter-gram at 20 deg. C. = 0.15263; per cent conductivity = 100.25. It is concluded that the best value to be assumed for the resistivity of annealed copper in the preparation of wire tables and in the expression of per cent conductivity, etc., is the previously used standard value, namely, 0.153022 ohm per meter-gram at 20 deg. C. The conductivity of hard-drawn No. 12 B. & S. wires was found to be less than the conductivity of annealed wires by a mean value of 2.7 per cent. The difference between the conductivity of annealed and hard-drawn wires increases as the diameter of the wire decreases. The lowest resistivity and highest conductivity found for a hard-drawn wire were: Resistivity in ohms per meter-gram at 20 deg. C. = 0.15386; per cent conductivity = 99.46; and for annealed wire were, resistivity in ohms per meter-gram at 20 deg. C. = 0.15045; per cent conductivity = 101.71. Representative mean values for commercial hard-drawn aluminum were obtained as follows: Resistivity in ohms per meter-gram at 20 deg. C. = 0.0763; resistivity in micro-ohms per centimeter cube at 20 deg. C. = 2.828; density = 2.70. The advantages of the expression of resistivity in ohms per meter-gram are stated. The desirability of an international standard of copper conductivity is urged.—*Bull. Bureau of Standards,* February.

Temperature-Resistance Coefficient of Copper.—J. H. DELLINGER.—An account of an extended investigation which shows that for representative samples of the copper at present furnished for electrical use the conductivity and temperature-resistance coefficient are proportional to a high degree of accuracy for differences in physical condition and to a fair accuracy for differences in chemical composition of samples. This relation may be put in the following very convenient form for reducing the results of resistivity measurements to a standard temperature: The change of the resistivity per degree C. of a sample of copper is 0.000598 ohm per meter-gram, or 0.00681 micro-ohm per centimeter cube. The distortions caused by bending and winding a wire are shown to produce no material change in the temperature-resistance coefficient; so that the temperature rise in machines and instruments may be calculated from measurements of the resistance of the windings with greater confidence than heretofore. The measurement of temperature-resistance coefficient is shown to present an advantageous substitute for the direct measurement of conductivity in a number of cases. A discussion is given of the mathematical relations between the different methods of expressing the temperature-resistance coefficient. In an appendix results of tests of the Reichsanstalt are given which confirm the author's results.—*Bull. Bureau of Standards,* Vol. 7, No. 1.

Effects of Bends on Inductance.—R. P. JACKSON.—An article on the effects of bends and loops on the inductance of a conductor. Bends and loops should be avoided because a crooked line cannot be the shortest one between the points. But the effect of bends and loops on the inductance is not as marked as is often supposed. No matter how crooked and intricate the path afforded by a conductor, so long as one loop does not lie over another its impedance cannot be greater and is, in fact, somewhat less than the same conductor stretched out straight. It is true, however, that such a tortuous path has greater impedance than one following an approximately straight line between the terminal points. The reason for this is explained. Bends, loops and corners are harmful only because they involve more length of conductor and not because such loops and bends in themselves increase the inductance. This is not the case, however, if one loop overlaps another. In this case the inductance increases in general as the square of the number of turns. Sharp points are bad, whether at bends of the conductor or elsewhere, but for reasons due to the static rather than the magnetic field.—*Elec. Journal,* September.

Calculation of Aluminum Lines.—G. BARON.—The author calculates the sag which must be given to aluminum wires to make sure that the tension never becomes greater than the maximum tension permitted by the German Association of Electrical Engineers, namely, 9 kg per square millimeter (12,800 lb. per square inch). The most unfavorable conditions assumed by the author relate to an additional load of ice of 15 grams per meter length and square millimeter surface (6½ lb. per foot length and square inch surface) at a temperature of — 5 deg. C. (+ 23 deg. F.). The general formulas for the solution of the problem are given and used to calculate a numerical table for convenient use.—*Bull. techn. de l'Assoc. de l'Inst. Elec. de Grénoble,* March, 1911; abstracted in *La Revue Elec.,* Aug. 11.

Automatic Protection of High-Tension Cables.—H. BIRKENBACH AND M. HÖCHSTÄDTER.—An English translation of their German paper recently abstracted in the Digest, in which the authors describe a new automatic protecting device for high-tension cable networks and mains invented by Mr. Höchstädter. Particulars of the installation at Cologne are given and the results of tests are also referred to.—Lond. *Electrician,* Sept. 29.

Electrophysics and Magnetism.

Production of Helium from Radium.—B. B. BOLTWOOD AND E. RUTHERFORD.—An account of a careful experimental investigation, the chief results of which are summed up as follows: The rate of production of helium by a radium salt has been accurately measured and has been found to be equal to approximately 0.107 cu. mm of helium per day per gram of radium (element), which is equivalent to 156 cu. mm of helium per year per gram of radium in equilibrium with its first disintegration products, the emanation, radium *A* and radium *C*. The rate of production, 158 cu. mm of helium per year, calculated by Rutherford and Geiger from the results of their experiments on the number of particles emitted by radium, is in excellent agreement with the rate of production which has been found. The amount of helium by the disintegration of a known quantity of radium emanation has also been measured and has been found to correspond with the amount to be expected from theory. The production of helium by polonium and from a preparation containing radio-lead has also been observed.—*Philos. Mag.,* October.

Alternating-Current Spark-Gaps.—W. WEICKER.—An illustrated translation of a German paper recently abstracted in the Digest in which the author examines the

methods of measuring alternate-current voltages by means of spark-gaps and shows the various influences that must be taken into account for purposes of correction. He defines the "initial voltage" and the "limiting voltage of brush discharge" and shows how these are affected by the nature of the electrodes, by the length of the spark-gap, by moisture, atmospheric pressure, ultra-violet light and other disturbing influences.—Lond. *Electrician,* Sept. 22.

Electrochemistry and Batteries.

Electrode Control in Electric Furnaces.—E. Ragonot.—An illustrated description of the automatic system of electrode control in use at the Keller-Leleux electric furnace plant in Livet, France. The Routin automatic regulator is employed, the arrangement being shown in Fig. 2. *F* is the Keller electric furnace, with one terminal of the

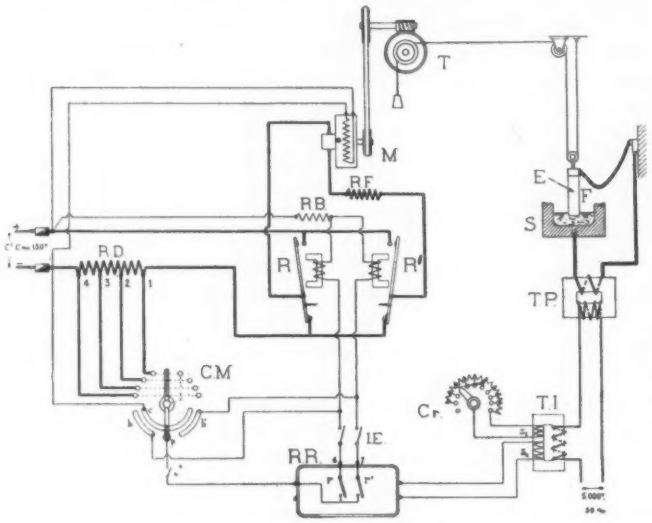


Fig. 2—Diagram of Connections of Control System.

electricity supply in the bottom of the crucible *S* and the other terminal in form of a movable electrode *E* at the top. *E* is suspended by means of a chain, one end of which runs over the endless screw axle *T* as shown in the illustration. This axle is driven by belt from the motor *M* and the electrode *E* is thus raised or lowered. The 5000-volt alternating-current supply which feeds energy to the furnace *F* through the intermediary of the transformer *TP* is shown at the right-hand bottom corner of the diagram. An auxiliary 150-volt, direct-current supply is shown at the left hand of the diagram; it feeds energy to the motor *M* which raises or lowers the electrodes. This motor *M* is shunt-excited (the excitation current being taken from the 150-volt supply just mentioned). In normal operation (that is, with the connections as shown in the diagram) the armature of the motor *M* will receive no current, being short-circuited through the resistor *RF*. It is only when either the relay *R* or the relay *R'* has been acted upon by the electromagnet device that the armature of the motor *M* will be connected in one or the other way to the 150-volt direct-current supply system and will begin to rotate in one or the other direction, thus raising or lowering the electrode *E*. The electromagnetic device which operates the relays *R* and *R'* can be actuated either by hand by means of the commutator *CM* or automatically by means of the Routin regulator *RR*. The relays *rr'* in the latter would be too weak to actuate directly the motor *M* for raising or lowering the electrodes; they, therefore, serve only to actuate the main relays *RR'*. The primary of the transformer *TI* is in series with the primary of the furnace transformer *TP*. The transformer *TI* has two secondary windings, one of which s_2 supplies the current for actuating the relays *rr'*, while the other s_1 is an auxiliary winding, short-circuited through the resistor of adjustable resistance *Cr* for the following purpose. In electric furnace plants it is necessary to be able to vary the load within rather wide limits, corresponding to primary currents between 40 amp and 100 amp. For any load the current must be maintained constant with an accuracy of 2 per cent. In order to accomplish this, without changing the primary winding, use is made of the rheostat *Cr*, which permits adjustment of the load of the secondary winding s_1. For operation by hand the commutator *CM* is used, which permits starting the motor *M* in one or the other direction and also permits regulation of the speed by short-circuiting a greater or smaller part of the resistor *RD* in the circuit of the armature. The interrupter *i* (at the side of the commutator *CM*) permits one to cut the regulator out if desired.—*La Revue Elec.,* Sept. 8.

Units, Measurements and Instruments.

Resistor of Variable Low Resistance.—J. H. Dellinger.—A description of a very simple resistor of variable low resistance, the operation of which depends on the fact that mercury has approximately sixty times the resistivity of copper. The apparatus consists simply of a tube of thin glass (thick glass may be broken by scratching of the copper wire), or of porcelain or hard rubber, with a slight enlargement at the upper end to receive the mercury when displaced by the descending copper wire. An amalgamated copper wire of slightly smaller diameter than the internal diameter of the tube is lightly gripped either by a cork placed in the top of the tube or by a pair of springs faced with insulating material. A length of 15 cm is convenient. A 1-ohm range is obtained by using a tube of about 0.4 mm diameter and any other range down to 0.01 ohm is obtained by tubes up to 4 mm diameter. In the first of these mercury resistors of variable resistance a flexible lead wire was connected to the upper end of the copper wire, and to prevent opening the circuit when the wire was wholly withdrawn from the mercury a wire shunt was connected across the terminals. An improvement in the arrangement is to connect simply to the top and the bottom of the mercury column. Thus there is nothing whatever connected to the plunging copper wire which functionates simply by short-circuiting the mercury. A simple and valuable modification is the use of two of these resistors in series by the employment of a glass U-tube of which the diameter of one leg is $\sqrt{10}$ times the other. Thus a pair of resistors of variable resistance of the ranges 0.1 ohm and 0.01 ohm are conveniently obtained. The use of the U-tube eliminates the difficulty of sealing the lower end. A scale may readily be attached and when the instrument has been calibrated the resistances of its settings are known. The instrument should not usually be employed for exact quantitative work, however, as it has a large temperature-resistance coefficient. The mercury resistor of variable resistance has been applied to facilitate adjusting to a balance the auxiliary ratio arms of the Thomson bridge, in the comparison of low-resistance standards, and its use materially increases the speed of working. It is especially valuable in the measurement of the resistance of wire samples for determination of the conductivity, since the magnitude of the ratio arms may be very different for every sample measured. The application of this device to alternating-current bridge work has been productive of good results. The precision of determination of low values of inductance may be increased by the use of ratio arms of lower resistance. This has been made convenient by the use of the mercury resistor. It was found that, fortunately for alternating-current work, this resistor has practically non-variable inductance (at any rate for modern frequencies). This is evident if the copper wire is of practically the same diameter as the mercury column, as the geometry of the circuit is not changed by varying the resistance. Thus this instrument is a complementary apparatus to the usual

variable inductance. The total change of inductance of one of these "mercury variables" 15 cm long, about 1.5 mm internal diameter of tube, 1 mm diameter of copper wire, and a range of 0.05 ohm, was 6×10^{-9} henry, or 6 cm.—*Physical Review,* September.

Measuring the Torque of Electrical Instruments.—P. G. Agnew.—An illustrated description of an instrument which while specifically designed for the determination of the torque of electrical measuring instruments is generally applicable to the measurement of small horizontal forces. It operates on the pendulum principle, as shown in Fig. 3, the essential feature being the use of a scale *S*

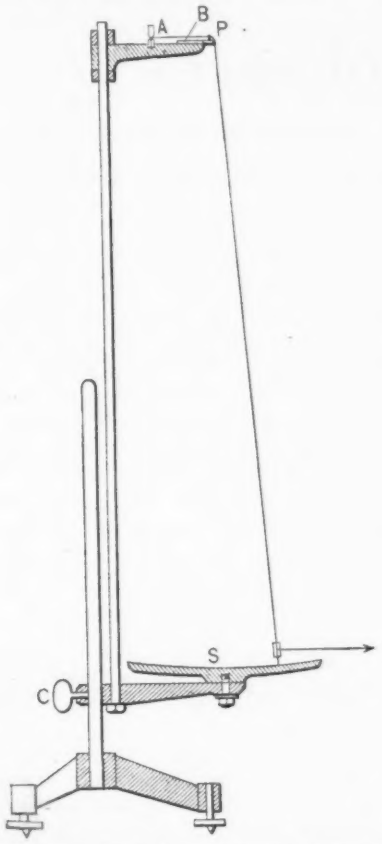


Fig. 3—Device for Measuring Torque.

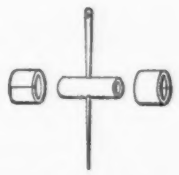


Fig. 4—Details of Bob.

on a concave spherical surface turned from a brass casting to a radius of curvature of 1 m. The bob, which is supported from an adjustable arm, is so arranged that the point of support *P* is at the center of curvature of the spherical scale. A silk fiber used for suspension is wound on a friction pin *A* for convenience in adjusting its length. The fiber passes through a V-shaped notch in the end of a brass strip *B*, which is capable of a small horizontal adjustment to aid in the initial centering. The whole is mounted on an ordinary clamp stand, the tripod being fitted with leveling screws. The clamp *C* allows the scale and bob to be lowered as a unit for convenience in applying to an instrument. The graduations of the scale consist of 153 concentric circles, the distance between successive circles being approximately 1 mm. The diameter of the scale is 30 cm. Since the horizontal deflecting force varies as the tangent of the angle of displacement, it is necessary, in order that the instrument should be direct reading, that the circles be so spaced as to indicate the tangents of the angles of deflection directly. The bob consists of a small hollow brass cylinder with a fine sewing needle passed through it perpendicular to the axis, as shown in Fig. 4. The silk fiber by which the horizontal force to be measured is transmitted to the bob is attached to the needle and passes out along the axis of the hollow cylinder. The point of attachment is made at the center of mass of the bob, which, for convenience, is marked by a file scratch. The mass of the bob alone is adjusted to 0.5 gram, but in order to change the range concentric cylinders, each cut in halves, are made to fit snugly over the inner cylinders, as is indicated in Fig. 4. These extra cylinders make the total mass 1 gram, 2 grams, 5 grams, 10 grams and 20 grams respectively, giving a range of 40 to 1 for full-scale deflection. In measuring the torque of the deflection instrument—for example, a voltmeter—the horizontal thread is fastened to the pointer at a convenient distance from the pivot, the whole pendulum system adjusted to the proper height and the voltmeter moved horizontally until the desired deflection is produced. In this case torque = arm $\times$ weight $\times$ 0.001 $\times$ reading in divisions. In the case of a watt-hour meter it is necessary only to attach the thread to the edge of the disk, apply current and voltage to the meter and allow the thread to wind upon the disk as far as it will—*Bull. Bureau of Standards,* Vol. 7, No. 1.

High-Frequency Alternating Currents in Linear Conductors.—H. W. Edwards.—An account of an experimental investigation of the distribution of current and the variation of resistance in linear conductors of square and rectangular cross-section when carrying alternating currents of high frequency. Alternating currents were produced by the discharge of a condenser through an inductive resistor, with sufficient uniformity of current to render possible their use in precise measurements. A description is given of an ammeter suitable for the measurement of the intensity of alternating currents. The frequency of alternating currents was measured by a photographic spark counter for any frequency up to 750,000 per second. By checking Maxwell's formula for the virtual resistance of cylindrical wires it is shown that the damping of the oscillating currents used is small enough to be neglected. The ratio of the virtual to the direct-current resistance for copper wires of square and rectangular cross-section was measured by the use of a differential thermometer and these observed values were checked by approximate formulas within certain limits. For the two square cross-sectioned wires tested this limit was for frequencies above 150,000 and for the two rectangular cross-sectioned wires the limit was about 150,000. Formulas are developed by certain assumptions in the general theory, which give approximate methods of calculating the ratio of the virtual to the direct-current resistance. The validity of these assumptions is based upon experimental results. In the development of the expression from which the ratio of resistances is calculated there occurs an expression for current intensity at any point of the cross-section of the conductor. This expression is used to calculate, for some particular cases, the distribution of current intensity within the cross-section.—*Physical Review,* September.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—A note on a recent British patent (20,441, Sept. 21, 1911) of the Marconi Wireless Telegraphy Company and Mr. J. H. Round. To reduce the effects of powerful atmospheric discharges a variable conductor and a receiver in the form of a Fleming valve, both of the unidirectional type, are connected in opposition and in parallel as shunts to the receiving circuit. The variable conductor operates only when acted upon by powerful oscillations, so that when the circuits are in tune signals can be received as long as they are not strong enough to affect the conductor; but, on a discharge taking place, the two valves become equally operative, and, being in opposition, no sound is produced. The filaments of the valves are rendered incandescent by current from two batteries, one in each circuit, adjusted by resistances. Potentiometers are also provided for varying the voltage across the valves, so that the sensitiveness of the conductor of variable conductance can be adjusted.—Lond. *Elec. Eng'ing,* Sept. 28.

Book Review.

Oekonomische Erzeugung und Verwertung Elektrischer Energie. By Adolf Prasch. Vienna: Joseph Eberle & Company. 276 pages, 134 illus. Price, 3.80 marks.

This little book is Part I of the sixth volume in a uniform series of books on engineering subjects. It covers the general theory of electromagnetism, the production of electromotive force, the characteristics of direct-current and alternating-current generators and motors, transformers and storage batteries, the performance of prime movers obtaining energy from steam, water, gas or oil; the operation of arc lamps, mercury-vapor lamps, incandescent lamps, Nernst lamps, switches, rheostats, fuses, lightning arresters, meters, transmission lines and cables. The treatment is brief and to the point, the physical relations being outlined without resort to mathematical proof or formularization. The material is arranged for ready reference, and as such should prove of value, although the book contains almost no operating data or design details.

New Apparatus and Appliances

ELECTRICAL APPARATUS AT BREWERS' EXPOSITION.

Electrical machinery is found to be efficient and convenient by brewers as well as by other manufacturers. At the American Exposition of Brewing Machinery, Materials and Products, held at the Coliseum, Chicago, from Oct. 12 to Oct. 21, and said to be the first exhibit of the kind held in the United States, there were several exhibits of electrical interest. A conspicuous feature was a well-made model of a modern brewery, operated by electricity and provided with miniature electric lamps. A large proportion of the machines in the various exhibits were shown in operation, electric motors being utilized for the purpose. There were twenty-one General Electric motors in service for this purpose and also a number of Westinghouse, Crocker-Wheeler, Fort Wayne, Roth and other motors.

The General Electric Company made an exhibit showing an electric beer-vat drier. This is an electric-heating device especially designed for brewers' use during the vat-varnishing season. A new General Electric machine shown in this exhibit was an ozonator designed for use on direct-current circuits. Direct-current and alternating-current motors were also exhibited.

Allis-Chalmers Company exhibited two motors, a 7½-hp induction type K motor and a 5-hp direct-current machine. A 10-kva transformer was included in the exhibit.

Charles L. Kiewert Company, of Milwaukee, had an exhibit beneath two Alba flaming-arc lamps made in Germany and for which this company is the American agent.

Electric Storage Battery Company displayed a few Ironclad Exide cells.

H. W. Johns-Manville Company had a characteristic exhibit including fuses and electrical specialties.

Fairbanks, Morse & Company, Chicago, had a display consisting of direct-current and alternating-current motors.

The Schneible Company, of Buffalo, made a machinery exhibit including electric centrifugal pumps and electric gas compressors.

Cutler-Hammer motor controllers were rather conspicuous in connection with a number of the motors in service in exhibits.

The Terry Steam Turbine Company, of Hartford, Conn., displayed a small single-stage steam turbine directly coupled by a horizontal shaft to a 15-kw generator. A turbine wheel showing the method of blading was also exhibited.

Vilter Manufacturing Company, Milwaukee, exhibited a large horizontal compressor for refrigerating work, as well as other machinery of this character. A vertical compressor made by this company was operated in the basement.

The York Manufacturing Company, York, Pa., exhibited several refrigerating machines, both horizontal and vertical, of the single-acting and double-acting type. This company also had a vertical machine in service in the basement. This compressor was driven by a 15-hp motor and used for the purpose of cooling beer.

The General Vehicle Company, Long Island City, displayed a 3½-ton electric chassis for heavy commercial service. A 5-ton electric brewery truck was also shown.

The Hohmann & Maurer division of the Taylor Instrument Companies, Rochester, N. Y., had an exhibit of temperature-indicating instruments of particular interest. A novelty was a mercury thermometer so connected as to indicate by electrical means at a distance the temperature where the thermometer is placed. For instance, the engineer of a power plant connected with a meat-packing establishment can ascertain by the use of this device the temperature of the chill room at any time by pressing a button on a wall indicator and noting the light flashed up under glass-covered openings corresponding to the scale on the thermometer tube.

ELECTRICAL EXHIBITS AT ILLINOIS STATE FAIR.

Increasing attention is paid to the state fairs by manufacturers of electrical apparatus. At the recent Illinois State Fair in Springfield, which attracted a large attendance, there were several exhibitors who showed electrical machinery or appliances. The General Electric Company was one of these. This company has already exhibited at the Wisconsin and Iowa state fairs this year, and it plans to exhibit also at the Oklahoma, Texas, Mississippi, Georgia and other state fairs. Its display at Springfield was shown in a tent and included a gasoline-engine, direct-connected electric-lighting set, the dynamo of which was rated at 3 kw and wound for 110 volts. The gas engine of this unit is of the four-cylinder type. In parallel with this machine was a single-cylinder gas-engine-driven unit, and the two were operated in parallel with excellent regulation. There was also a considerable display of heating and cooking devices of interest to residents of rural districts, including an electric range.

The International Harvester Company of America had a large exhibit in a tent. It included two 25-hp, two-cylinder gas engines made by the exhibitor and belted to 16-kw Fort Wayne direct-current, 110-volt dynamos. These dynamos furnished energy to about 1100 incandescent electric lamps, arranged in festoons in the interior of the tent and also placed on posts. These lamps ranged from 2-cp carbons to 40-watt tungstens. A 5-hp electric motor operated a line of gas engines of different sizes, and an exhibit of twine-making machinery was driven by a 7.5-hp motor. A 5-hp motor operated an exhibit of spreaders, while 4-hp machines were used to demonstrate in action a number of corn pickers, hay loaders and corn shellers.

In a separate tent the International Harvester Company

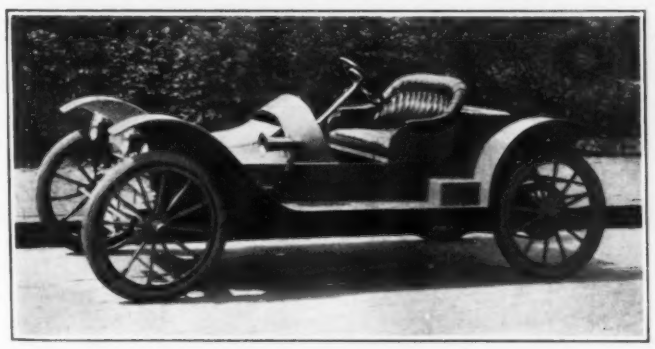
exhibited its "power-house on the farm." This consisted of a 6-hp gas engine belted to a line shaft, from which a 2-kw, 30-volt, Fort Wayne direct-current motor was driven. From this line shaft were also operated corn shellers, feed grinders, an emery wheel, a washing machine, a churn, cream separators, a grindstone and a pump. The installation included a sixteen-cell storage battery of National cells, made by the United States Light & Heating Company. A feature of this little power plant was a small switchboard panel made by the Cutler-Hammer Manufacturing Company, containing a voltmeter and an ammeter, with an ingenious arrangement of switches so designed that the outgoing circuits could be fed either from the dynamo or the battery by one movement of the switch handle. The switchboard is also provided with a low-voltage cut-out of the lever type.

Fairbanks, Morse & Company exhibited a low-voltage farm-lighting plant, consisting of a gas engine driving a small dynamo, from which was charged a sixteen-cell storage battery made by the Electric Storage Battery Company. The exhibit was lighted by thirty-six 20-watt Mazda lamps, and electricity was also supplied for a low-voltage fan and a washing machine. The dynamo is rated at 28 amp at 32 volts. A neat switchboard panel completed the exhibit.

A large number of gas and oil engines were exhibited, and the Root & Van Dervoort Engineering Company, of East Moline, Ill., exhibited a gasoline engine driving a dynamo, from which its exhibit was lighted and which also served to supply energy for an electric sign. The Columbia Engine Company, of Detroit, Mich., showed some interesting examples of kerosene engines. The American Electric Company, of Chicago, showed a number of electrical and telephone specialties, and Joseph Barnett & Company, of Riverside, Ia., exhibited their copper-cable lightning rods and fixtures.

HIGH-SPEED, LONG-RANGE ELECTRIC PASSENGER VEHICLE.

In the accompanying illustration is shown an electric vehicle designed for the severe duty of covering 80 miles in four hours running time under ordinary conditions of country roads. The established fact that the car maintained an average running speed of 20 miles per hour for 244 miles between Boston and New York shows that it can perform the service satisfactorily. Moreover, six cars,



Electric Roadster.

duplicates, of the one here illustrated, have been ordered by the Edison Electric Illuminating Company of Boston to replace gasoline passenger cars used by heads of departments.

Being designed for business service and ease of riding the car differs essentially from all other electric or gasoline cars. The wind resistance has been minimized. The body is set very low with a low center of gravity, but it is suspended from the upper side of the springs. The frame is built of wood strongly braced with steel.

In the spring suspension lies the secret of the car's easy riding qualities. The chassis is supported on a three-point suspension. There are the conventional full elliptic springs in the rear, and in the front there is mounted a cross spring from which the upper part of the body is suspended. The action of the front spring and axle is such that the car is capable of traveling over the worst of roads at high speed without discomfort to passengers.

The car is equipped with Edison storage battery, the battery and motor being proportioned according to the mileage and speed required. The standard equipment consists of fifty cells of the A-6 type, from which the travel obtained is between 80 and 120 miles at a speed of 20 miles per hour.

Use is made of a speed controller placed on the top of the steering wheel in the location occupied by the throttle on a gasoline car. There are eight forward and four reverse speeds; the reversing switch is operated by a pedal.

The car is one that should prove especially useful for public service corporations on account of its great mileage, high speed, easy riding and simple operation. It has been placed on the market by S. R. Bailey & Company, Amesbury, Mass.

CHICAGO FALL AUTOMOBILE OPENING.

From Oct. 7 to 14 the Chicago Automobile Trade Association gave a "fall opening" on Automobile Row; that is, Michigan Avenue from Twelfth Street to Twenty-eighth Street. Nearly all the members of the association took part in the opening, decorating their stores in gala attire and setting forth their cars and accessories in the most attractive shape, making particularly prominent the new models and devices of the fall season. During the evening free demonstration cars were run along the street and on Oct. 9, which was "fire-prevention day" in Chicago, in memory of the great Chicago fire of forty years ago, the automobilists combined with other bodies and the city authorities in a civic celebration.

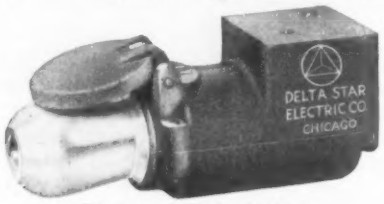
While most of the exhibits shown in the stores and on the street related to gasoline cars, there were nevertheless a number of electric machines which figured in the "opening," including those made by the Anderson Electric Company, Baker Electric Company, Borland Electric Company, Flanders Manufacturing Company, Hupp-Yeats Corporation, C. P. Kimball & Company, Ohio Electric Vehicle Company, The Rauch & Lang Carriage Company, Studebaker Corporation, Waverley Company and Woods Electric Automobile Company. In addition there were several members of the association who called attention to electrical accessories to the automobile trade. Among these were the Hessler Storage Battery Company, Dolly Electric Company, Vesta Accumulator Company, Winter Battery Company and Witherby Igniter Company.

Electrical street decorations were a prominent feature of the opening. Between Twelfth Street and Twenty-eighth Street, a distance of about two miles, Michigan Avenue was spanned with eighty-six festoons, each supporting forty 16-cp incandescent electric lamps. These festoons were in turn supported from span wires attached to buildings. They were suspended from the span wires by two vertical wires and by this means the festoon was divided into three portions of about equal length.

In addition, at street corners or at equivalent intervals in the cases of long blocks, ornamental wooden posts were erected. There were sixty-four of these posts in all and each was surmounted by a 16-in. opal glass globe containing a 250-watt tungsten lamp. Each post also supported from corner brackets four ornamental colored lanterns in imitation art glass and each of these lanterns inclosed a 16-cp carbon lamp. Mr. Homer E. Niesz was the contractor for the electrical decorations and also for supplying electricity to the lamps during the week of the "opening."

A NEW PLUG AND RECEPTACLE.

The increasing use of portable electric translating devices, such as small motors, lamps, batteries, etc., has developed a demand for a plug and receptable which more nearly conforms to modern requirements than the older



Plug and Receptacle.

form of devices, and to meet this need the Delta-Star Electric Company, Chicago, is placing on the market the device illustrated herewith.

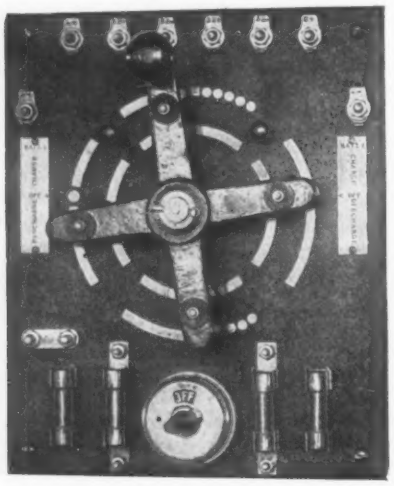
In general, the considerations involved in the design of plugs and receptacles are to provide means for carrying the rated current of the device without excessive drop or heating and carry such overloads as may be encountered in actual practice, and the insulation of all live parts for maximum potential in a permanent manner, both electrically and mechanically. These features have been embodied by the designers in the present type.

The receptacle consists of an iron shell containing two flat contacts mounted in a fireproof insulating body impervious to moisture, acids or oils. This material has high insulation and mechanical strength, rendering impossible short-circuiting between the terminals. The receptacle can be mounted on a horizontal, vertical or angular position, as desired. The plug consists of a metal shell containing two flat contacts imbedded in insulating material, and so designed that they lock into the receptacle contacts, thus preventing accidental opening of the circuit. All parts are made with dies, insuring interchangeability, which is a very essential feature in railroad service.

SMALL BATTERY CHARGING AND TRANSFER PANEL.

The panel shown in the accompanying illustration, which has been recently placed on the market by the Cutler-Hammer Manufacturing Company, of Milwaukee, is for use with battery systems where two batteries are employed, one of which is a reserve battery under charge, while the other is on the working line. Duplicate batteries arranged in this manner are used on circuits for electric clocks, railway signals, electric bells in schools and other buildings, the batteries being alternated as the working battery becomes discharged. This panel allows the transfer of batteries without interrupting the working circuit, which is very important in many cases. On an electric-clock system the contact by the master clock might occur when circuit is open and cause the secondary clocks to be fifteen to twenty seconds slow.

The charging rate can be varied without disturbing the working circuit, each of the contact buttons, shown at top and bottom of the accompanying illustration of the panel, forming a resistance step. These panels are ordinarily made for use on 110-volt direct-current circuits. A snap switch is provided for stopping the charge when the desired maximum voltage is reached. One fuse of each the charging and the working circuit has additional terminals on front of the panel, so that an ammeter can be conveniently cut in on either circuit without interrupting the circuit. Automatic means for cutting out the battery when charged and transferring batteries on the working circuit when either reaches a minimum voltage can also be provided if desired.



Battery-Charging Panel.

DIFFUSING GLASSWARE FOR INCANDESCENT LAMPS.

The Haskins Glass Company, Wheeling, W. Va., has brought out what is termed "Lucida" glass, possessing desirable illuminating qualities. The glass is translucent in that it entirely hides the form of the radiant and appears uniformly illuminated throughout its surface. Moreover, the glass possesses a large degree of reflecting power so that when properly shaped it affords an excellent diffusing reflector. It has a low coefficient of absorption with high diffusive power besides having a pearly lustre yielding a shimmering effect by transmitted light. The curves show that the distribution of light is such that there is neither a bright spot directly underneath the reflector nor wide distribution dissipating the light over a wide area. Both the outer surface and the inner surface of the glassware have their natural glaze unroughened by acid or sand blasting so that it can be readily cleaned.

The peculiar nature of the "Lucida" glassware adapts it equally to all styles of finish and design; it harmonizes with bronze, iron, brass, gilt or silver metal work and can be treated in any "period" or style of decorative art after the manner of sculptured alabaster or in the simpler motives characteristic of the glass-blower's art. It is made up in the following shapes: Bowl type, flat or flared type, semi-flared type, mission bell type, two-piece ball globe type, and in hemispheres.

Fig. 1—Diffusing Reflector.

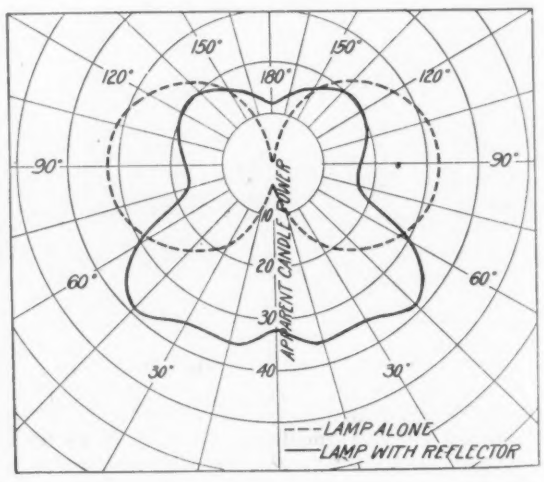


Fig. 2—Distribution from 40-Watt Lamp with Reflector.

Industrial and Commercial News

The Week in Trade.

WHILE demand for immediate necessities furnishes the chief source of new business at present, buoyancy has been imparted to the buying movement by the prevalence of low prices. Attracted by these, consumers are placing orders on a broader scale for replenishing stocks, though most of the contracts are for early delivery. Price reductions have greatly broadened operations in the steel trade, and both inquiries and orders are being received in encouraging volume. In some branches of the trade, notably structural steel and pipe, mills are working at a high rate of capacity. The broader demand for steel from shipyards and builders is an indication of expansion throughout the country. Conditions in the pig-iron market are still unsatisfactory. In addition to lack of demand, producers are showing little disposition to close term contracts at the low prices now quoted. Aside from scattering orders for small amounts, there have been few features of interest in the pig-iron market during the week. Price revisions on cotton goods have had a beneficial effect and buyers in dry-goods and textile lines are showing a wider interest in contracts for the future.

Acceptance of the plan for disintegration of the American Tobacco Company, filed on Monday, in compliance with the decree of the United State Supreme Court, will furnish a needed guide to business interests at large, in that it helps to point out the way to meet the requirements of anti-trust laws and relieve the business tension. Trade as a whole indicates that steadying influences are making headway and that confidence is being established. Growth of new enterprises and of plans for utilization of idle capital is becoming more pronounced. Business failures for the week ended October 12, as reported by *Bradstreet's*, were 212, as compared with 201 last week, 233 in the corresponding week in 1910, 220 in 1909, 244 in 1908, and 194 in 1907.

The Copper Market.

FROM present indications the October report of the Copper Producers' Association will be even less favorable to producers than was the case in September. A heavy decrease has taken place in both foreign and domestic consumption, and as output shows no signs of curtailment a large increase in surplus stocks is expected. In anticipation of this poor showing consuming interests are not responding to the present scale of copper prices, holding to the belief that the trend of the market will force them still lower. With electrolytic now bringing from 12.10 cents to 12.20 cents cash, and lake copper quoted at 12¼ to 12⅜ cents cash for October and November delivery, earlier predictions for 12-cent copper before the end of the year seem probable of fulfilment. Purchases are in very small lots for both domestic and foreign interests. Inquiry from abroad, while encouraging, does not approach in volume that of the first half of the year. Standard copper in New York is very dull, and deviation from the positions cited in the table has been slight. Statistics of operations in the copper trade show that 1,078,909,598 lb. of copper were produced in the United States in the past nine months and that this total is .3 per cent less than in the corresponding period last year. Shipments to domestic consumers in this time aggregate 511,515,058 lb., or 11.3 per cent under the total in the same months of the previous year. Exports in the past nine months amounted to 548,529,887 lb., or 9 per cent in excess of the showing in the preceding year. Total deliveries in the period were 1,060,044,937 lb. and this was 1.4 per cent under the deliveries in the corresponding period of 1910. In the current month, including October 17, exports aggregate 9619 tons. The daily call on the Metal Exchange October 17 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.25	....
October	12.00	12.25	12.12½
November	12.00	12.25	12.12½
December	12.00	12.25	12.12½
January	12.00	12.25	12.12½

The London market, Oct. 17, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	55	2	6	55	18	9
Standard copper, futures	55	0	0	55	16	3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.35c	11.57½c
London, spot	£57 10 0	£55 7 6
London, futures	58 2 6	54 0 0
Best selected	61 10 0	57 5 0

Industrial and Commercial Notes.

Montreal Tramways Makes Proposal for Acquisition of Street Railway Company.—Samuel T. Mains, secretary of the Montreal Tramways Company, has sent a notice to stockholders of the Montreal Street Railway Company in which he offers to exchange the stock of the latter for cash, debenture stock and ordinary stock of the Montreal Tramways Company, in accordance with an agreement recently entered into with the street railway company for acquisition of its property. The notice calls attention to this agreement and states that among other considerations on the part of the tramways company it has agreed to pay and deliver to shareholders of the Montreal Street Railway Company, on completion of transfer to it, $438.75 in cash, $800 in 5 per cent debenture stocks, and $100 in ordinary shares of the tramways company, for each five shares of the street railway stock held by any street railway stockholder as shown by the registry of the company. Fractional certificates will be issued to holders who do not own five shares or an exact multiple of five shares. The notice says further that at the meeting of the street railway shareholders at which the agreement for acquisition of the property was approved a number of shareholders requested that the tramways company deliver $1,250 in 5 per cent debenture bonds and $100 in ordinary shares, against each five shares of street railway stock, to those holders who preferred not to take cash, and this request, according to the circular, will be acceded to by the tramways company. Funds for acquisition of the property will be obtained from proceeds of the $10,000,000 first and refunding 5 per cent bonds sold to American banks, as mentioned in the last issue.

Underpaid Letters.—The United States Consul-General at Tientsin, China, in a late report says that his office still receives letters from the United States with 2-cent stamps affixed and on which the consular officer must pay 6 cents when they are delivered. He mentions this fact for the reason that many American firms appear to pay no attention whatever to affixing the proper amount of postage on their foreign letters. A somewhat general canvass of the leading import firms of Tientsin reveals the fact that the receipt of underpaid letters from the United States is so common that the firms generally refuse to accept them unless the envelope shows the address of some American firm with whom they are in communication.

Contracts Awarded for New York Skyscraper Equipment.—Messrs. Mailloux & Knox, of New York City, designers of the electrical equipment for the fifty-five story Woolworth building, now in course of erection at Broadway, Park Place and Barclay Street, New York City, have awarded a contract to the Providence Engineering Works for tandem-compound engines, aggregating 2300 hp, for this building, and to the Babcock & Wilcox Company for the boilers. The elevators will be furnished by the Otis Elevator Company. Awards for the generators and switchboards will be announced later.

New Screw and Bolt Factory to Be Electrically Operated.—The Gary Screw & Bolt Company, which is building a new factory at East Gary, Ind., now nearing completion, has entered into contract with the Northern Indiana Gas & Electric Company of Hammond, Ind., for 750 kw of electrical energy which will be used to operate the machinery in the factory, as electric drive will be employed throughout. The energy will be supplied to the factory as 440-volt alternating current.

La Crosse Dam Will Be Rebuilt.—Under charge of W. J. Ferris, president of the La Crosse Water Power Company, the portions of the dam at Hatfield wrecked Oct. 6, as described in the previous issue, will be rebuilt as rapidly as possible. The cost of repairs is estimated at $100,000.

Philadelphians Will Investigate City Lighting Contract.—With reference to rumors that an investigation is to be made of the contract with the Philadelphia Electric Company for lighting the city, Logan M. Bullett, of the Citizens' Committee, stated as follows: "This is one of the matters we have had under consideration almost from the time of formation of the committee, and in due time we expect to ask an investigation of the subject. We have all the necessary data respecting the prices paid by the cities of Philadelphia, Baltimore, Chicago and elsewhere for municipal electric lighting and are prepared to place our information in the hands of the Catlin commission."

Idaho Properties Sold to Pittsburgh Interests.—J. S. and W. S. Kuhn, of Pittsburgh, who are interested in irrigation work in Southern Idaho, have purchased the holdings of the Boise & Interurban Railway of Boise, which operates between Boise and Caldwell, and the transaction involved the transfer of between $2,000,000 and $3,000,000 in securities. Negotiations for purchase by the same interests of the Boise Railroad Company, Ltd., and the Boise Valley Railway Company are expected.

Will Extend Lines in Northwest.—Preparations are being made by engineers representing the Pacific Power & Light Company for surveys of the territory between Wallula and The Dalles, where high-tension transmission lines will be erected for supplying energy in this section. The line will be about 130 miles in length and its cost will approximate $375,000.

American Capitalists to Operate Canadian Traction.—Negotiations are said to be in progress for a merger of the Brantford (Ont.) Street Railway and Grand Valley lines into an electric system, with a view to extension from Toronto to Detroit. American capitalists are interested in the project.

Aluminum Notes and Prices.—The aluminum market as of October 17, is reported quiet, with ingots for remelting quoted at 20@22 cents spot No. 1, the base for large ingots. Rods and wire are held at 31 cents and sheets at 33 cents.

Financial.

The Week in Wall Street.

DISCUSSION of the plan for reorganization of the American Tobacco Company has occupied Wall Street throughout the week. Business interests in general are awaiting presentation of a method whose acceptance as conforming to anti-trust laws will relieve uncertainty and assist revival of trade, but in spite of this desire for advancement considerable opposition has been offered to the present plan on the ground that it does not provide for restoration of competitive conditions. Even if the plan proves satisfactory to the Supreme Court, there is likelihood of another period of uncertainty before ratification by that body takes place. Public interest in the market is still very light, and professional trading is easily recognized in the transactions. Profit-taking sales at the opening on Monday, with selling centering on United States Steel, lowered prices rather generally, though recovery toward the close showed gains in the majority of issues. The market was equally irregular on Tuesday, though the volume of sales was smaller than on the previous day. Revival of the rumor of a government suit against the Steel Corporation took place during the day, but was denied by representatives of the Attorney-General in a statement to the effect that no suit has been filed against the company. There is a great deal of speculation on this matter, however, and many in financial quarters are expecting to hear of a suit after the return of the President to Washington. Advance in sterling exchange rates to a figure that was not only the highest figure for the year but was in excess of gold export rates a short time ago was made on Tuesday. In view of the abundance of idle money and the condition of general business, American bankers are finding satisfactory outlets for their funds in foreign money markets. Rates in the money market Oct. 17 were: Call, 2⅜@2½ per cent; ninety days, 3½@3¾ per cent. The quotations in this table are those at the close Oct. 17.

NEW YORK.

	Oct. 10.	Oct. 17.	Shares Sold.		Oct. 10.	Oct. 17.	Shares Sold.
Alt. Ch.....	3	2½	9,445	Int. Met., pf.	45	44½	1,600
All. Ch. pf...	12½	10	2,565	Mackay Cos..	85*	85*	300
Amal. Cop....	49⅜	51⅞	31,300	Mackay, C.,pf.	72½	72½	400
Am. D. T....	33⅛*	33⅛*	———	Man. Elev....	132*	134½*	100
Am. Loco....	34¼	35	800	Met. St. Ry..	15*	15*	———
Am. Loco. pf.	105*	104*	500	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	80½*	78*	25	Steel, com....	59	59¾	378,500
Am. T. & T..	134⅝	135⅜	5,385	Steel, pfd....	109	109⅜	4,530
B. R. T.....	74¼	75	9,200	W. U. T.....	79¼	78⅛	5,200
Gen. Elec....	149½	150¾	4,150	West'h, com..	61¼	65½	2,075
Int. Met.....	14⅞	14½	1,800	West'h, pfd...	115	115*	200

PHILADELPHIA.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Am. Rys.....	44	43½*	Phila. R. T.....	21¾	23¼
El. Co. of A.....	11¾	11¾	Phila. Elec.....	16⅜*	16¼
Elec. St. Bt'y.....	51¼	52⅜*	Phila. Trac.....	83	83½
Elec. St. Bt'y., pf...	30*	30*	Union Trac.....	49½	51⅛

CHICAGO.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Chi. City Ry.....	186*	186*	Com. Edison.....	135¼	128⅜
Chi. Elev. Rys.....	24*	27	Chi. Subway.....	1¾	1½
Chi. Elev. Rys., pf...	89½*	90*	Chi. Telephone.....	120	119½*
Chi. Rs., Ser. 1.....	92*	92*	Nat'l Car.....	101*	101*
Chi. Rs., Ser. 2.....	27*	27*	Nat'l Car, pf.....	118½*	118½*

BOSTON.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Am. T. & T.....	134⅝	135⅜	Mex. Tel.....	3*	4*
Cum. Tel.....	149⅞	150½	Mex. Tel., pf.....	6*	6*
Edison	285	284	N. E. Tel.....	146	146
Gen. Elec.....	149½	150¾	W. T. & T.....	19	19½
Mass. E. Ry.....	19⅜	19¾	W. T. & T., pf.....	95⅛	95⅛*
Mass. E. Ry., pf....	92	93			

*Last price quoted.
Shares sold for the week Oct. 9 to Oct. 14.

Financial Notes.

Commonwealth Power, Railway & Light Company.—Owing to dullness in business in Grand Rapids, Mich., and to increase in the wages of its employees, the Commonwealth Power, Railway & Light Company, operating in that section, did not make as favorable a showing in the month of August, 1911, as it did last year. While gross earnings increased nearly $18,000, or 4¼ per cent, as compared with those in August, 1910, net earnings decreased about $11,500, or 4¼ per cent, and the surplus over charges for the month represented a falling off of $15,500, or more than 30½ per cent as compared with the record in the same month in the previous year. The eight months ended Aug. 31, 1911, however, show improvement over those in the corresponding period last year. Gross earnings were $3,507,170, an increase of 7.35 per cent, and net earnings were $1,661,590, an increase of 4.70 per cent, in spite of an increase of 9.86 per cent in operating expenses. Charges were $1,021,509, an increase of 3.26 per cent, leaving net profits of $640,081, representing a gain of 7.07 per cent. Preferred stock dividends amounted to $240,123, an increase of 0.12 per cent, and the surplus was $399,958, which was 11.72 per cent in excess of that in the corresponding period last year

Kings County (N. Y.) Electric Light & Power Company.—Gross earnings of the Kings County Electric Light & Power Company in September were $377,816, representing an increase of $24,926 as compared with those in September, 1910. Operating expenses were $195,735, an increase of $13,792, or a little over half the gain in gross returns. Net earnings were $182,081, showing an increase of $11,134. Bond discount was $1,689 and depreciation was $46,621, or $2,472 in excess of this item in September, 1910. Fixed charges were $70,547, an increase of $7,370, leaving a surplus of $63,224, which, in spite of the increase in charges, was $1,292 in excess of the surplus in the corresponding month last year. Gross earnings in the nine months ended Sept. 30 were $3,443,532, an increase of $297,029, and operating expenses were $1,733,327, an increase of $213,511. Net earnings were $1,710,205, which was an increase of $83,518 over net earnings in the first nine months of 1910. Bond discount was $15,202, and depreciation charges were $417,948, an increase of $42,522. These deductions left a balance of $1,277,055 an increase of $40,996, which was offset by fixed charges of $593,139, an increase of $50,243 over those in this period in 1910. The surplus was $683,926, which represents a decrease of $9,247.

American Telephone & Telegraph Company.—Total revenue of the American Telephone & Telegraph Company for the quarter ended September 30, 1911, was $9,094,370, as compared with $8,714,616 for the corresponding quarter last year, and the balance after dividends was $1,345,735, as compared with $1383220. Expenses in the period were $890,743 as compared with $884,416, deduction of which left net revenue of $8,203,626, which compares with $7,830,199 in 1910. Interest

charges were $1,401,539, as compared with $1,249,941, leaving a surplus available for dividends of $6,862,088, as against $6,580,-259 last year. Dividends amounted to $5,516,353, as compared with $5,197,035 in the corresponding quarter of 1910.

United Railways & Electric Company.—The Maryland Public Service Commission has received the annual report of earnings of the United Railways & Electric Company for the fiscal year ended June 30, 1911. The report conforms in every way to the requirements of the commission, and is the second annual document prepared under the new form as prescribed by the Public Service Commission act. In the report the United Railways places the gross earnings of the road for the twelve months at $7,851,290, as compared with $7,456,783 for the previous year, or a gain of $394,506 for 1911. Operating expenses for the year were $3,655,063, as compared with $3,421,-803 for 1910, making a gain of $233,260 for the fiscal year just ended. Operating net revenues were $4,196,226, as compared with $4.034,980 for the preceding fiscal year, the increase for 1911 being $161,245. Miscellaneous income for the twelve months, including interest on deposits, income from securities owned, as well as other income, amounted to $15,311, as against $87,367 for the previous twelve months, making the gross income of the company for the year, less operating expenses, $4,211,537, as compared with $4,043,717, an increase of $167,-820.13 for 1911. The taxes of the company, including payments on real and personal property, on capital stock, etc., amounted to $731,957. Deductions of interest on the corporation's funded and floating debt, together with other deductions, amounted to $2,852,934 for the twelve months, which deducted from the gross income of the property, less operating expenses, gives a net income of $1,358,602 for the year. During the year the extraordinary expenses of the company were $864,048, as contrasted with $1,013,413 for 1910. In addition $60,000 was applied to the sinking fund of the Maryland Electric Railway Company's 5 per cent bonds. Dividends of 2 per cent on $53,000 of the company's preferred stock amounted to $1,060, and interest on $13,947,000 income bonds totaled $278,940. The United's surplus for the year, as given in the report to the Public Service Commission, totaled $154,554, as against $271,364 last year. At the beginning of the fiscal year the company had a surplus of $652,331, which added to the $154,554 gives a total surplus of $806,885, as compared with $734,771 for 1910. During the fiscal year the company paid to the Mayor and City Council the balance of the assessment tax for the years 1907, 1908 and 1909 and on the corporation's capital stock for the years 1908 and 1909, which, together with other deductions, leaves a final surplus of $773,490 for the year, as contrasted with $652,331 for 1910.

Washington, Baltimore & Annapolis Electric Railway.—Officials of the Washington, Baltimore & Annapolis Electric Railway Company have issued a statement of earnings for September, which shows that the total income for the month was $15,829, as compared with $8,423 in September, 1910. Gross operating revenue was $67,261, as compared with $68,659, or a decrease of $1,387. Operating expenses for the month were $30,070, as against $29,217, this being an increase of $852 as compared with September of last year. The net operating revenue for the month amounted to $37,191, as compared with $39,442 in September, 1910, representing a decrease of $2,250. Miscellaneous income totaled $226, as compared with $120 for September of 1910, or a gain of $105. Gross income for the month was $37,417, as against $39,563, or a decrease of $2,145. Interest, taxes, etc., for the month amounted to $21,587, as against $31,139 for the corresponding month of the previous year, and deduction of this item from the gross income of the property left a surplus of $15,830 for the month, or an increase of $7,405. The percentage of operating expenses to gross operating revenue was 44.70 per cent, as compared with 42.56 per cent for September of 1910. The gross operating income of the company for the six months of the new fiscal year, which began April 1, is placed at $377,128, as against $369,453 for the corresponding period in 1910, a gain of $7,674 for this year; operating expenses were $174,710, as compared with $176,587 for 1910, a decrease of $1,856, while the gross income for the six months was $203,527, as against $193,456 in 1910, an increase of $10,171 for this year's operation. The interest charges and taxes for the period totaled $133,502, as against $185,612 for 1910, a reduction of $52,110. The surplus for the six months is placed at $70,025, which compares with $7,743 for the previous year, an increase of $62,281. After the reorganization plan was put into effect Washington, Baltimore & Annapolis officials thought that their company, with a good year, would be able to close the fiscal year with a surplus of $100,000. From the statement issued last week, showing a surplus of over $70,000 at the end of the first six months of the new fiscal year, it is seen that the company is more than meeting this expectation.

New England Telephone & Telegraph Company.—The noteworthy feature of the report of the New England Telephone & Telegraph Company for the year ended June 30, 1911, as filed with the Massachusetts Highway Commission, is the large increase in expenses. From a total income of $13,400,000 only $2,888,000, or about 20 per cent, was available for dividends, representing 7.37 per cent on $39,178,100 capital stock whereas in the previous year, with a total income of $12,525,000, the amount saved for dividends was $3,525,000 or nearly 30 per cent, representing 9 per cent on the same amount of capital stock. Much of the increase in expenses, it is stated, is due to physical alterations to the properties of the company and not to the reductions in rates previously noted in these columns. While the decrease in gross income from this source is expected to reach $600,000 ultimately, it is confidently believed that this amount will be speedily regained by the revenue from new business induced by lower rates. Another item affecting the expense account this year was a general increase in wages. In spite of the heavy operating costs which this company has had to meet this year no difficulty has been experienced in meeting the dividend requirements, which, as mentioned in the *Electrical World*, July 1, were increased from 6 per cent to 7 per cent in June of this year. After payment of this a small balance was left. The stockholders of the company now total about 4,000 and the average holding, not including the 228,866 shares owned by the American Telephone & Telegraph Company, is 40 shares.

Earnings of Chicago Elevateds.—The reports of the Metropolitan West Side Elevated and the South Side Elevated companies for the year ended June 30, 1911, have been filed with the Illinois Railroad and Warehouse Commission. Gross earnings of the former were $3,180,327, as compared with $2,991,368 last year, and operating expenses were $2,773,964, as compared with $2,567,145. The surplus available for dividends decreased from $424,223 in 1910 to $406,363 in 1911. After charges and dividends, the balance was $145,126. Gross earnings of the South Side Elevated were $2,419,922, as compared with $2,348,135 last year and operating expenses were $2,065,-169, as compared with $2,046,250 in 1910. Net profits were $354,753, as compared with $301,885 in the previous year, and after payment of charges and depreciation the surplus was $74,550.

DIVIDENDS.

American District Telegraph Company of New Jersey, quarterly, 1 per cent, payable Oct. 28.

Connecticut Railway & Light Company, quarterly preferred and common, 1 per cent, payable Nov. 15.

Guanajuato Power & Electric Company, quarterly preferred, 1½ per cent, payable Nov. 1.

Havana Electric Railway Company, quarterly, preferred and common, payable Nov. 11.

Houghton County Electric Light Company, semi-annual preferred, 75 cents per share; common, 62½ cents per share, both payable Nov. 1.

Lowell Electric Light Corporation, quarterly, $2 per share, payable Nov. 1.

REPORTS OF EARNINGS.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
9m., Sept.,' 11.	$27,297,994	$2,673,204	$24,624,789	$4,207,423	$20,417,366
9m., Sept., '10.	26,310,511	2,578,901	23,731,609	3,836,296	19,895,313

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

Sept., 1911....	$377,816	$195,735	$182,080	$118,856	$63,224
Sept., 1910....	352,889	181,942	170,947	109,015	61,932
9m., Sept., '11.	3,443,533	1,733,328	1,710,205	1,026,280	683,925
9m., Sept., '10.	3,146,503	1,519,816	1,626,687	933,514	693,173

METROPOLITAN WEST SIDE ELEVATED RAILROAD COMPANY.

Yr., June, '11.	$3,180,327	$2,773,964	$406,363	.....	.....
Yr., June, '10.	2,991,368	2,567,145	424,223	.....	.....

OREGON ELECTRIC RAILWAY COMPANY.

Yr., June, '11.	$616,079	$323,512	$267,404	$100,000	$167,404
Yr., June, '10.	474,867	274,120	191,239	100,000	91,239

RUTLAND (VT.) RAILWAY, LIGHT & POWER COMPANY.

Yr., Sept., '11.	$309,198	$164,121	$145,076	$90,995	$54,081
Yr., Sept., '10.	270,197	139,732	130,464	84,651	45,807

SOUTH SIDE ELEVATED RAILROAD COMPANY.

Yr., Sept., '11.	$2,419,922	$2,065,169	$354,753	.....	.....
Yr., Sept., '10.	2,348,135	2,046,250	301,885	.....	.....

General News

Construction News.

DECATUR, ALA.—The City Council is considering the question of issuing bonds to the amount of $50,000 for the construction of a municipal electric-light plant.

TROY, ALA.—The Pea River Power Company has awarded a contract for the construction of a dam across the Pea River at Elba. It is expected that 2000 hp will be developed for transmission by electricity to the towns of Troy, Dothan, Elba and others. Charles Henderson, of Troy, is said to be financing the enterprise.

PHOENIX, ARIZ.—The Salt River Valley Electric Railway Company, recently incorporated, has applied for a franchise for an electric railway in Phoenix. If granted a franchise the company proposes to extend its system to Scottdale, a distance of 11 mile. F. M. Winter is interested in the company.

TUCSON, ARIZ.—Plans are being considered for the erection of a central electric power plant for the Hart Ranch, near Shawnrita, to supply electricity for a pumping system. Dietrich & Goetz, of Tucson, Ariz., are engineers.

ARKADELPHIA, ARK.—The Southwestern Telegraph & Telephone Company has purchased nine local exchanges of the North Arkansas Telephone Company, giving the Southwestern company a toll line along the Missouri & North Arkansas Railway into Eureka Springs and northwest Arkansas territory. The exchanges are located at Arkadelphia, Malvern, Lonoke, Scarcy, Heber Springs, Leslie, Marshall, Conway and Morrillton.

BAKERSFIELD, CAL.—Preparations are being made by the San Joaquin Light & Power Company to erect a transmission line from Bakersfield to the Weed Patch Company's property, a distance of 17 miles. The San Joaquin company will supply electricity for a number of power plants to be installed in that vicinity.

DIXON, CAL.—Arrangements are being made by the Pacific Gas & Electric Company for rewiring the residence portion of the city for the purpose of establishing a twenty-four-hour service. Flat rates will be discarded and meters installed throuhout the entire system.

GRIMES, CAL.—The Pacific Gas & Electric Company is making arrangements to extend its transmission line from Knight's Landing to Howell Point to supply electricity for operating pumps for irrigation purposes.

HAWTHORNE, CAL.—The Southern California Edison Company has been awarded a contract by the Board of Supervisors of Los Angeles County for the installation of seventy-five street lamps in Hawthorne.

LOS ANGELES, CAL.—The Pacific Light & Power Company has taken out a permit to build an addition to the transformer house at its Hollywood substation.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has placed an order with the General Electric Company for one motor-generator set, one 17-kw, 500-125-volt exciter and three 450-15,000:13,500-2250-volt core-type transformers.

MARYSVILLE, CAL.—The installation of an ornamental street-lighting system on D Street has been assured by contributions from business firms and property owners amounting to $5,000. The committee is now collecting funds for installing arches at Third and E Streets and also at Third and C Streets. It is planned to light the entire business district with arches.

MODESTO, CAL.—The Sierra & San Francisco Power Company has taken over the property of the La Grange Water & Power Company in Modesto. It is said that the transformers and other equipment of the Sierra company will be transferred to the Oakdale station of the company. The Sierra company will remove its offices and equipment to the office of the La Grange company.

ONTARIO, CAL.—An agreement has been entered into between the Ontario Power Company and the Southern California Edison Company whereby the Edison company is to furnish the local company with electricity in case of emergencies or when extra heavy demands are being made upon it and the Ontario company is to supply the Edison company with its surplus. The new arrangements will prevent the necessity of enlarging the steam plant for emergencies. The steam plant will not be discarded but will be used when needed.

PORTERVILLE, CAL.—The Tulare County Power Company expects to be ready to deliver energy to its patrons not later than April, 1912. This company is a co-operative concern and each share of stock carries with it an agreement from the company to deliver 1 hp of electricity annually. The substation from which the electrical energy will be distributed in the orange district will be located near Strathmore, work on which will begin in the near future. A site has been secured in Tulare for a station which will supply electricity in the dairy district, and where a steam auxiliary plant will be located.

ROSEVILLE, CAL.—A committee has been appointed to negotiate with the Pacific Gas & Electric Company for the purchase of the local electric-light plant.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has applied to the Board of City Trustees for franchises to extend its system into the annexed districts.

SAN BERNARDINO, CAL.—The Southern Sierras Power Company has awarded the contract for the construction of a one-story power house, 66 ft. x 67 ft., in San Bernardino, to Hoyt Brothers, Monadnock Block, San Francisco, Cal., for $20,000. The work includes the foundations for the machinery, which will be installed by C. C. Moore Company, of San Francisco, Cal., to cost about $150,000.

SAN FRANCISCO, CAL.—The contract for furnishing and installing steam turbines, generators and main switchboard in power house and laundry building in the Hall of Justice has been awarded to Frederick C. Roberts & Company, of San Francisco, Cal., for $23,198.

SAN FRANCISCO, CAL.—The Western Power Company has filed a certificate with the Secretary of State at Trenton, N. J., showing an increase in capital stock from $18,000,000 to $20,670,000. E. E. Hawley is president of the company and H. P. Wilson secretary.

SAN FRANCISCO, CAL.—Plans and specifications are being prepared by the Bureau of Engineering as follows: (a) For construction of fire alarm and telephone central building; (b) for furnishing and installing lateral and miscellaneous ducts and setting box standards; (c) for furnishing and installing telephone cable and appurtenances; (d) for furnishing and installing telephone equipment and batteries; (e) for furnishing and installing telephone boxes and standards; (f) for furnishing and installing gasoline engine and electric generator with auxiliaries; (g) for furnishing and installing motor-generator set with switchboards.

STOCKTON, CAL.—The Sierra & San Francisco Power Company has commenced the construction of a transmission line from Manteca to Stockton. The company has notified the city authorities that it would build a distributing system in Stockton, with underground conduits in the business district. An auxiliary steam generating plant will be erected. H. Jackson is assistant manager.

TULARE, CAL.—The Tulare County Power Company is reported to have awarded the contract for the construction of a 3000-hp steam turbine plant for irrigation purposes to the Hunt-Mirk Company, of San Francisco, Cal.

DENVER, COL.—The Denver City Tramways Company is planning to build an extension along Colorado Boulevard and Twenty-ninth Avenue, in Denver.

LAMAR, COL.—The plant and holdings of the Lamar Light, Heat & Power Company have been purchased by the Associated Engineers' Company, of Colorado City, Col. The new company, it is said, will make extensive improvements to the property. T. L. Wilkinson, of Denver, Col., is president of the Associated Engineers' Company and E. C. Van Deist, of Colorado Springs, secretary.

PUEBLO, COL.—The Pueblo & Suburban Traction & Lighting Company will soon place contracts for laying about 6 miles of track and two concrete bridges.

TRINIDAD, COL.—The Trinidad Electric Transmission, Railway & Gas Company contemplates the purchase of two 2000-kw turbines, three 1000-kw transformers, coal-handling machinery, boilers with a rating of 1000 hp and stokers for its power plant in Trinidad, and also rebuilding about 19 miles of track in the near future.

NEW HAVEN, CONN.—The Shore Line Electric Railway Company has awarded the contract for the construction of an extension between Ivorytown and Deep River to the Cavanaugh-McCaffrey Company, of Boston, Mass. It is expected that the railway will be extended to Chester as soon as the right-of-way is secured.

SAYBROOK, CONN.—At a town meeting held recently the citizens voted to instruct the Selectmen to enter into a contract with the Essex Light & Power Company to light the streets of the town for a period of five years, the cost not to exceed $1,050 per annum.

AUBURNDALE, FLA.—The city is reported to be contemplating the installation of a light, water and ice plant and a telephone exchange.

BROOKSVILLE, FLA.—It is reported that the proposition to grant a franchise to Mr. Fuller, of Umatilla, to construct an electric-light plant and water-works system in Brooksville, will be submitted to a vote.

JACKSONVILLE, FLA.—Contracts have been awarded by the Board of Bond Trustees as follows: To the H. W. Clark Company, for furnishing meter box tops; to the Allen Contracting Company, for moving condensers to the new power plant; for new switchboard, to the General Electric Company; for boiler, brick and flue work, to the Rust Engineering Company, and to the Allis-Chalmers Company, for rewiring generator.

MADISON, FLA.—The Town Council has made arrangements for the

purchase of the local electric-light plant, owned by the Madison Electric Power Company. The proposition offered by the Council and accepted by the company calls for payment of $30,000 for the plant payable at the end of twenty years, with interest at 6 per cent payable yearly.

ST. AUGUSTINE, FLA.—The plant and holdings of the St. Johns Light & Power Company were sold at auction on Oct. 3 to the Inter-City Securities Company at $180,000. The plant will be operated as at present and B. E. Dyson, receiver, will be in charge until the company is reorganized.

ATHENS, GA.—Owing to the low water in the Oconee River the hydroelectric power plants which supply electricity for the street railways and lighting in Athens are closed down. The large steam plant of the Athens Railway & Electric Company is in full operation for the first time for years.

SOUTH BOISE, IDAHO.—The Board of Village Trustees has granted the Great Shoshone & Twin Falls Water Power Company a franchise to supply electricity in South Boise for a period of forty-one years.

ABINGDON, ILL.—The Abingdon Electric Company, of Abingdon, Ill., has been granted a franchise to supply electricity in Prairie City. The Prairie City municipal electric-light plant was recently destroyed by fire, and since that time that city has been without electrical service. The Abingdon company will erect a high-tension transmission line from Abingdon to Prairie City, a distance of 14 miles. Electricity will be furnished by the company in St. Augustine and also probably to the farmers along the line. In addition to erecting the line the company will install a new Corliss engine and a generator in the local plant. The proposed addition will involve an expenditure of about $10,000.

ARTHUR, ILL.—The Arthur Mutual Telephone Company has purchased a site on which it proposes to erect an exchange building.

CHICAGO, ILL.—Plans for the proposed municipal tuberculosis sanitarium to be erected at North Fortieth Street, between Bryn Mawr and Paterson Avenues, Chicago, Ill., provide for an administration building power house, dining room and service building, three infirmary buildings, two nurses' homes and ten open-air cottages with a capacity of twenty patients each. The cost of the buildings is estimated at $818,323.

CHILLICOTHE, ILL.—A committee has been appointed by the Business Men's Association to take charge of installing an ornamental lighting system in Chillicothe.

CHILLICOTHE, ILL.—The People's Telephone Company has sold its system to E. S. Sterrett, C. A. Camp, of Henry, Ill., and C. B. Cheadle, of Joliet, Ill. A franchise has been granted the new owners both in the city of Chillicothe and the village of North Chillicothe. It is said that the plant will be entirely overhauled and the wires placed underground. A new building will be erected at Third and Pine Streets and a new switchboard and central-station equipment and new cables will be installed.

ELGIN, ILL.—The Commercial Club is interested in the proposition to install an ornamental street-lighting system in the business district in Elgin.

GALVA, ILL.—The Commercial Club is considering plans for the installation of an ornamental street-lighting system in the business district. It is proposed to erect ornamental standards with cluster lamps. The establishment of a municipal electric-light plant is reported to be under consideration.

GREENVILLE, ILL.—The question of substituting ornamental lamp standards for the present arc lamps is under consideration.

JACKSONVILLE, ILL.—The Jacksonville Railway & Light Company is installing a 500-hp McIntosh-Seymour engine in its power house in Jacksonville.

MATTOON, ILL.—The Chamber of Commerce is planning a campaign to extend the ornamental street lighting system recently inaugurated throughout the entire business district.

MORRISON, ILL.—The question of building an interurban railway from Rock Island to Albany, through Morrison, Sterling and Polo to Rock Ford, is under consideration. M. T. McCaskey, of Chicago, Ill., is interested in the project.

MOUNT VERNON, ILL.—The Citizens' Gas, Electric & Heating Company is contemplating extensive improvements and extensions to its plant, including increasing the capacity of its reservoir from 30,000,000 to 50,000,000 gal., by raising its dam 2 ft. A new engine and generator is being installed. F. M. Sinsabaugh is manager.

PAXTON, ILL.—The Consumers' Electric Light, Heat & Power Company is reported to have submitted a proposition to install an electric plant in Paxton, to cost about $75,000. The company asks for a thirty-year franchise and a ten-year contract for street lighting.

PEORIA, ILL.—The village of Averyville has granted the franchises asked for by the Peoria City Railway Company and the Peoria & Northern Railway Company. Work will start at once, it is reported, on the proposed improvements, which will involve an expenditure of about $70,000.

PETERSBURG, ILL.—The Central Union Telephone Company and the Petersburg Telephone Company has been consolidated under the name of the People's Telephone & Telegraph Company, of Menard County. The new company will be capitalized at $100,000. The incorporators and officers are: H. H. Colby, of Petersburg, president; George H. Rottger, of Springfield, secretary, and D. W. Frackelton, of Petersburg, treasurer.

TUSCOLA, ILL.—The Douglass County Telephone Company has secured the Jarmen Building and will install a modern exchange.

ANDERSON, IND.—The Indiana Service Company, which recently filed articles of incorporation with the Secretary of State, in addition to furnishing electrical service in several cities and townships will also supply gas and water service. C. W. Hooven, one of the incorporators, is president of the Anderson Gas Company, and also controls the natural gas plant at Shelbyville, Elwoods and Anderson. Artificial gas will be generated and piped to various cities. Rushville, Connersville, Batesville, Tipton and Noblesville are included in the plans of the Indiana Service Company. Howard L. Olds and John T. Bacon now control the light and water service at Newcastle and Rushville.

BRAZIL, IND.—The City Council has granted the Retail Merchants' Association permission to install cluster lamps on eight blocks on Main Street.

CANNELTON, IND.—At an election held recently in Cannelton, Troy and Tell City, in Perry County, the voters approved of a subsidy of 2 per cent to aid the Vincennes & Cannelton Traction line. The proposed railway has been surveyed into Cannelton from Vincennes via Petersburg, Huntingburg and Ferdinand. Work must begin on construction of the road within ninety days.

ELWOOD, IND.—Preparations are being made for the installation of an ornamental street-lighting system in the business district. The present plan calls for the erection of five-lamp standards on each of the four corners of Main and Anderson and Main and Sixteenth Streets and the remainder of the standards will carry three lamps and will be set 60 ft. apart. The merchants and property owners will pay for the installation of the system.

GARY, IND.—The Indianapolis, Chicago & Meridian Railway Company has been granted a fifty-year franchise to operate a street railway on Seventeenth Avenue and a cross street route with a western terminus at the Hammond boundary.

INDIANAPOLIS, IND.—The American Traction & Power Company, a Delaware corporation, will open an office in the Aetna Building, Indianapolis, Ind. The company is a holding corporation for electric railways and power plants now in course of construction in Mississippi and Kentucky. H. C. Brubaker is president of the company and G. K. Bruce secretary.

KENTLAND, IND.—R. W. Howard, who has been granted a franchise to supply electricity in Kentland, will also supply electrical service in Brook, Goodland and Sheldon. A twenty-four-hour service will be furnished. Work has begun on construction of the plant.

MONTEZUMA, IND.—At a special election held recently the citizens voted to build an entire new electric-light and power plant. The proposition submitted was to repair the old plant or build a new one.

PORTLAND, IND.—Subsidies of $5,000 each were voted by Monroe and Wabash Townships to aid in the extension of the Fort Wayne and Springfield Traction line south of Portland.

COLUMBUS JUNCTION, IA.—The City Council has called a special election to be held Nov. 4 to vote on the proposition to grant a franchise to E. M. Miller, of Greeley, Col., and R. D. Parks, of Lake Crystal, Minn., to install an electric-light plant in Columbus Junction.

DES MOINES, IA.—An order has been placed by the Des Moines City Railway Company with the General Electric Company for a switchboard for its plant at Des Moines.

DES MOINES, IA.—The State Board of Agriculture, it is reported, has found that it can secure electricity cheaper from the local company for use at the Iowa State Fair than to use the electric plant which was installed three years ago.

HAMPTON, IA.—At an election held recently the proposition to renew the franchise of the Hampton Electric Light & Power Company was defeated. The present franchise has five years to run.

MANCHESTER, IA.—The City Council has granted Joseph Huntchinson an electric-light and power franchise for a period of twenty-five years. Under the terms of the franchise the plant must be in operation prior to Oct. 1, 1912. Mr. Hutchinson owns the Quaker mill property, north of the city.

NASHUA, IA.—The Nashua Power Company, recently incorporated with a capital stock of $21,000, will erect and operate an electric plant in Nashua. G. T. Greeley, G. C. Hoover, W. A. Granger, W. F. Getsch and J. W. Kipple are interested in the company.

OELWEIN, IA.—Orders have been placed by the Oelwein Light, Heat & Power Company for a new generator for its power house. The company is increasing the output of its plant to supply electricity to operate the piano factory of Gamble Robinson and other manufacturing establishments. R. W. Sanders, of Chicago, Ill., is president of the company.

POCAHONTAS, IA.—Sealed bids will be received by George Schneiders, city clerk, until Oct. 27 for furnishing material and installation of a complete electric-light plant for the city of Pocahontas. Bids will be received on the entire plant and on various portions thereof. Alternate bids are requested on a gas-producer plant, high and low-speed steam plants and oil-engine equipment. The work will include brick or concrete power house, steam, gas-producer or oil-engine plant, 40-kw or 50-kw generator, pole line and wiring and all accessories. Plans and specifications are on file and may be seen at the office of the city clerk, Pocahontas, Ia., and at the office of the Oscar Claussen Engineering Company, 514 German National Bank, St. Paul, Minn., where copies of plans and

specifications may be secured on application to the company. A charge will be made for the reproduction of the plans.

HUTCHINSON, KAN.—Preparations are being made by the United Water, Gas & Electric Company for the erection of a high-tension transmission line from Hutchinson to Nickerson to supply electricity in the latter city. The company will also supply electrical service to farmhouses along the line.

LAWRENCE, KAN.—The County Commissioners have decided to purchase a portable electric-light plant for the new County Home. It is stated that a small plant can be purchased for about $1,000. The gas engine which operates the generating plant will be used for pumping water.

NEWTON, KAN.—The local electric-light plant, owned by the Newton Electric Light & Power Company, has been purchased by the Kansas Gas & Electric Company. It is understood that the power plant will be closed down and energy for operating the system will be supplied from the power plant of the Kansas company in Wichita. A new substation will be erected which will supply electricity for local consumption in Newton and for operating the Arkansas Valley Interurban Railway. The company's lines are now within 6 miles of Newton. The present plant will be held for emergencies. The price paid for the plant and holdings is said to be about $125,000. The Kansas Gas & Electric Company will issue bonds to the amount of $204,000 for the purchase of and improvements to the property. James D. Newton, present manager, will remain in charge of the plant.

SYRACUSE, KAN.—The contract for installing the proposed municipal water and light system in Syracuse has been awarded to the J. S. Worley Engineering Company, of Kansas City, Mo., at $35,800.

HICKMAN, KY.—The Kentucky Southwestern Railway, Light & Power Company is making a preliminary survey for its proposed electric railway between Paducah, Ky., and Union City, Tenn.

LOUISVILLE, KY.—The stockholders of the Louisville & Nashville Railroad Company have voted to establish a telephone and telegraph service along the line of the railroad. The new wires will also handle public business. The telegraph service has been furnished by the Western Union Telegraph Company since 1884.

WHITESBURG, KY.—The installation of an electric-light plant in Whitesburg is under consideration. Jasper Bowens, of Polly, is interested in the project.

ALEXANDRIA, LA.—Orders have been placed by the electric-light committee for a 500-kw turbo-generator, to cost $10,396.

GLIDDEN, LA.—The installation of a municipal electric-light plant in Glidden is reported to be under consideration.

HOMER, LA.—The City Council has purchased the local electric-light plant, owned by Edward Sawyer, for $5,750. It is proposed to operate the plant in connection with the water-works system.

MONROE, LA.—At an election held recently the citizens voted to extend the water, light and sewerage systems in different parts of the city.

NEW ORLEANS, LA.—Proposals will be received by F. S. Shields, secretary, at the office of the Sewerage and Water Board, 508 City Hall Annex, New Orleans, La., until Nov. 7, 1911, for furnishing and installing the following machinery: One 6000-kw horizontal, high-pressure, condensing steam turbine and alternating-current unit; one 150-kw rotary converter with stationary transformers and one seven-panel switchboard. Specifications and blank form of proposals may be obtained upon application at the office of the board. George G. Earl is superintendent.

BANGOR, MAINE.—The Bangor Railway & Light Company is planning to replace its wooden dam at Veazie, Maine, with a stone and concrete structure. The Bangor Power Company, a subsidiary of the Bangor Railway & Electric Company, has built a temporary dam at Gilman's Falls, on the Stillwater branch of the Penobscot River, and is now building a concrete structure, which will complete the original project of the Bodwell Water Power Company at that point. The Bangor Railway & Light Company is now developing about 12,000 hp and with improvements under way or projected expects to increase its output by 10,000 to 15,000 hp.

LIVERMORE FALLS, MAINE.—Plans are being prepared by the Livermore Falls Light & Power Company for improvements to the street-lighting system in Livermore Falls. It is proposed to replace the present street lamps with 40-cp tungsten lamps.

NORWAY, MAINE.—The Norway & Paris Street Railway Company has awarded a contract to C. E. Hoxie & Company, of Augusta, Maine, for the construction of a new concrete dam at the outlet of Pennesseewassee Lake, in Norway.

PORTLAND, MAINE.—Sealed proposals will be received by the City Hall Building Commission, Portland, Maine, until Nov. 9 for lighting fixtures for the Portland city hall. Plans and specifications may be seen at the office of Carrere & Hastings, 225 Fifth Avenue, New York, N. Y., or John Calvin Stevens and John Howard Stevens, 187 Middle Street, Portland, Maine.

PRESQUE ISLE, MAINE.—The Aroostook Valley Railroad Company is reported to have secured permission from the New Brunswick provincial government for the construction of the St. John Valley Railroad along the St. John River from St. John to Grand Falls and St. Leonards. The proposed railway is to have a subsidy from the Canadian government.

BALTIMORE, MD.—The Subway Commission, it is reported, has petitioned the Board of Estimate for approval of plans calling for an additional appropriation of $1,000,000 to continue the construction of the subway system. Raleigh C. Thomas, electrical engineer of the commission, states that the Electrical Commission is planning to continue work on the underground conduit system during the coming year by extending trunk, lateral and distributing lines in practically all sections of the city.

MIDDLETOWN, MD.—The Frederick Gas & Electric Company, of Frederick, Md., is reported to have submitted a proposition to the Council offering to extend its electric transmission lines from Braddock Heights to Middletown.

BROOKVILLE, MASS.—The Randolph & Holbrook Electric Light Company, of Randolph, is installing a street-lighting system in Brookville. About 100 lamps will be erected.

GARDNER, MASS.—With a view of installing electricity in homes where a small number of lamps are required the Gardner Electric Light Company has submitted a proposition offering to install four 20-cp tungsten lamps at the rate of $1 per month. The company will wire the house at cost. Any one wishing more than four lamps may have them at the same rate, 25 cents apiece. In order to prevent trouble an excess indicator will be put in, which will cause all lamps to flash if more than four are used at one time.

LEOMINSTER, MASS.—The Selectmen and the special lighting committee have signed a contract with the Leominster Electric Light & Power Company for street lighting for a period of five years, under the terms of which the company agrees to replace the present arc lamps with tungsten lamps of 100 cp, of which there are 85. The moonlight schedule is to be abolished and all lamps will burn all night and every night. The company agrees to supply 100-cp tungsten lamps at $32.50 each per year; 80-cp tungsten lamps at $28.50 each and 60-cp tungsten lamps at $28.50 per lamp per year with all-night service. The 60-cp lamps burning until 1 o'clock will cost $18.24 each per year, and the 40-cp lamps $15 each per year on the same schedule.

PLAINVILLE, MASS.—At a special town meeting held Oct. 9 the Selectmen were authorized to enter into a contract with the Foxboro Electric Company, of Foxboro, Mass., for lighting the streets of the town for a term of three years. The contract calls for the installation of seventy-five lamps.

SPRINGFIELD, MASS.—The Gilbert & Barker Manufacturing Company, of Springfield, Mass., has awarded a contract to Fred Ley & Company, of this city, for the construction of its new plant for the manufacture of gas engines, to be located at Union and Spring Avenues, West Springfield. The new plant will consist of nine buildings and will contain a floor area of about 80,000 sq. ft. The plans include the installation of an electric-power plant.

MENOMINEE, MICH.—Preparations are being made by the Menominee & Marinette Light & Traction Company for increasing the output of its power plant in Menominee. New equipment will soon be purchased by the company, including one 1000-hp water turbine, one 1100-kw, 2200-volt, three-phase, 60-cycle generator, switchboard instruments and three 675-kw, 2200-33,000-volt transformers.

MINNEAPOLIS, MINN.—The Waveland Park Improvement Association is considering plans for lighting the Waveland district. F. W. Newell is secretary of the association.

MINNEAPOLIS, MINN.—Dr. P. M. Hall, city health commissioner, has commenced to advertise for private consumers to use electrical energy generated by an electric plant to be installed to utilize waste steam at the Minneapolis garbage crematory. There will be a surplus above the amount needed to light the workhouse, city buildings and grounds in the vicinity and the city attorney has ruled that private customers may be supplied.

MORRIS, MINN.—Plans have been prepared by Fairbanks, Morse & Company, of St. Paul, Minn., and submitted to the town of Morris for the installation of an electric-light plant, to cost approximately $15,000. A committee has been appointed to consider the proposition.

ST. PAUL, MINN.—The St. Paul Southern Electric Railway Company has consolidated with the Interurban Construction Company, of Hastings, Minn., and has awarded the contract for the construction of the proposed railway to Mankato to the Hoy & Elzy Company.

NEWTON, MISS.—The municipal electric-light plant has been placed in operation and is now supplying electricity for commercial and residential lighting. As soon as the plant is entirely completed the street-lighting system will be turned on. It has been decided to use the meter system throughout the entire system. The Newton Oil & Manufacturing Company has sold out its electric system to the city.

ST. LOUIS, MO.—The Tower Grove-Manchester Association is agitating the question of installing a new lighting system on Manchester Avenue.

ST. LOUIS, MO.—Work has commenced on the construction of a large building for the Laclede Gas Light Company, at the corner of Eleventh and Olive Streets, to cost about $500,000.

ST. LOUIS, MO.—The Union Electric Light & Power Company has announced a new schedule of rates for electricity for residential lighting to take effect from Oct. 20. Under the new schedule the maximum rate will be 11 cents per kw-hour and the minimum 6 cents per kw-hour.

WARRENBURG, MO.—The City Council, it is reported, has declared

in favor of municipal ownership of the electric-light plant and water-works system. The franchises of the companies now operating in Warrenburg will soon expire and a campaign for lower rates is on.

FORT SHAW, MONT.—The Sun River Irrigation Company will soon begin work on the construction of a telephone system between Willow Creek and Warm Springs. J. B. Bond is engineer.

WINNEMUCCA, NEV.—Work has begun on the construction of the power plant of the Winnemucca Water & Light Company. It is understood that orders have already been placed for machinery for the proposed plant.

TILTON, N. H.—The Tilton Electric Company is planning to install a 250-hp engine in its power plant. The company is increasing the output of its plant to meet the increasing demands for electrical service in both Tilton and Belmont.

DOVER, N. J.—Subject to the approval of the Board of Public Utility Commissioners a certificate has been filed with the Secretary of State consolidating the Bernards Electric Company, of Bernardsville, the Eastern Pennsylvania Power Company, of Dover, and the Warren County Power Company, whose registered office is at Jersey City. The new company will be known as the Eastern Pennsylvania Power Company and will be capitalized at $258,500, of which $157,000 will be given to the stockholders of the old Eastern Pennsylvania Power Company in exchange for their present holdings. The Bernards Water Company stockholders are to receive ten shares of new stock for each five held by them and the stock of the Warren company is to be exchanged for an equal amount par value of stock in the new company. It is said that the new company proposes to erect a large power plant in the vicinity of Mount Pocono.

JERSEY CITY, N. J.—Plans are being considered for installing an ornamental lighting system in the shopping district and placing the wires underground. It is proposed to erect brackets each carrying four lamps on the poles that carry the trolley wires. Under the terms of an agreement the Public Service Electric Company is to lay at least 2500 lin-ft. of conduits each year in any street or streets it chooses and 2500 ft. more in streets designated by the Street and Water Board.

MILLVILLE, N. J.—The City Council has passed an ordinance to submit the question of issuing bonds for the erection of a municipal electric-light and power plant to a vote of the people at the November election.

BINGHAMTON, N. Y.—Sealed bids will be received by S. W. Murray, secretary of Board of Contract and Supply, Binghamton, N. Y., until Oct. 25 for the construction of an electrical conduit system and installation of boulevard lamp-posts on Court Street. Plans and specifications will be furnished on application to J. A. Giles, city engineer. A deposit of $15 will be required, which will be refunded on return of plans.

BINGHAMTON, N. Y.—The contract between the city of Binghamton and the Binghamton Light, Heat & Power Company, whereby the city secures a three-year lighting contract under a new system that provides for an equal distribution of lamps throughout the city has been signed. Work will begin at once on erection of poles and wires. It is expected to have part of the system in operation within thirty days and the entire system by Jan. 1.

GENEVA, N. Y.—Plans have been prepared by the Central New York Gas & Electric Company for enlarging its Geneva plant, calling for an expenditure of about $40,000. The work will include the installation of a 520-hp boiler.

GROTON, N. Y.—The Board of Water and Light Commissioners is in the market for a 100 or 150-kw. direct-current, 250-volt, direct-connected steam-driven generating unit and balance set for three-wire system. E. R. Hayden is secretary.

LITTLE FALLS, N. Y.—The Utica Gas & Electric Company has submitted a proposal to the Board of Aldermen for street lighting, under the terms of which the company offers to supply arc lamps at $82.13 each per year and incandescent lamps at $24 per year. Under the present contract the city pays $35 per year per lamp for arc lamps and $12 each for incandescent lamps. The contract calls for 163 arc lamps and thirteen incandescent lamps. Owing to competition between the Utica Gas & Electric Company and the Hudson River Electric Power Company at that time, the city secured arc lamps for $35 per year and awarded a five-year contract to the Utica Gas & Electric Company.

PORT JERVIS, N. Y.—Plans are being considered for utilizing the water-power of Shohola Falls to generate electricity for transmission to Port Jervis. The present plan is to build a dam on Shohola brook at the falls, which are about 7 miles from where the brook empties into the Delaware River. The power house would be located near the river and the water conveyed to it by means of a large pipe line. John G. Hillard and W. V. Hillard, who own the Shohola property, are said to be interested in the project.

SELMA, N. C.—It is reported that extensions and improvements to the electric-light and water-works systems are contemplated, involving an expenditure of about $20,000.

SHELBY, N. C.—Negotiations have been closed between the Board of Aldermen and the Shelby Light & Power Company, whereby the town will take over the property of the Shelby company, at $13,000. The plant will be owned and operated by the municipality.

FINLEY, N. D.—The Finley Light & Power Company has awarded a contract to the Battery Power Company, of Milwaukee, Wis., for the installation of an electric-light plant.

CINCINNATI, OHIO.—The Ohio Electric Railway Company has commenced work on the erection of its substation at Herr's crossing in Urbana.

COLUMBUS, OHIO.—Bids will be received by H. S. Holton, director of public service, until Oct. 27 for furnishing material and installing a cluster lamp-lighting system for part of the city in accordance with plans and specifications on file in office of the director of public works and the Department of Lighting, Dublin Avenue, from whom copies may be obtained. The specifications call for 866 ornamental standards.

DELAWARE, OHIO.—The proposition to purchase the plant of the Delaware Electric Light, Heat & Power Company, to be owned and operated by the municipality, will be submitted to a vote of the people at the regular election to be held Nov. 7. The company has submitted a proposition to the City Council offering to sell the plant to the city for $137,500.

SPRINGFIELD, OHIO.—The question of installing an electric plant in the new high school building or substituting a transformer is under consideration by the Board of Education. The cost of installing a transformer is estimated at $1,200, while an electric plant would cost from $6,000 to $7,000.

VAN WERT, OHIO.—The Van Wert Public Service Company has submitted a proposal to the City Council for street lighting, offering to furnish 100 street arc lamps at $70 each per year and $65 per year for each additional lamp, under a moonlight schedule, and $80 each per year under an all-night schedule. The company agrees to substitute two series tungsten incandescent lamps for one arc lamp where desired. The Trinidad Power & Transmission Company, which was recently granted a franchise by the City Council to erect an electric-light plant in this city, failed to submit a bid, the reason assigned, it is said, being that the Auglaize Power Company, which is now building a hydroelectric plant and dam at Defiance, will be able to supply electricity at a rate which could not be touched by local steam plants and that it would be foolhardy to risk the investment required for the installation of an electric plant.

AFTON, OKLA.—The proposition to issue $20,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant and water-works system, will be soon submitted to a vote.

BARTLESVILLE, OKLA.—The Bartlesville Interurban Railway Company is building a new power house in Bartlesville. The equipment will include a 500-kw Allis-Chalmers turbine set with type "C" condenser. The company expects to install a 400-hp Babcock & Wilcox boiler.

CUSTER CITY, OKLA.—The Western Engineering Company is preparing plans and specifications for water-works and electric-light plant for Custer City, Okla., to cost approximately $40,000.

FAIRLAND, OKLA.—L. D. Long, it is reported, is planning to install an electric-light plant in Fairland. It is understood that an order has already been placed for machinery.

GROVE, OKLA.—Plans and specifications are being prepared by the Western Engineering Company for an electric-light plant and water-works system for Grove, to cost $35,000.

HOWE, OKLA.—An election will be held Nov. 4 to vote on the proposition to grant a franchise to the Howe Electric Light & Power Company to install an electric-light plant in Howe.

PAULS VALLEY, OKLA.—The Oklahoma State Corporation Commission has directed the Washita Electric Power Company, of Pauls Valley, to install a steam power plant as an auxiliary to its water-power plant, in order to supply adequate electrical service at all times. The company has increased its rate for energy from 12 cents to 15 cents per kw-hour.

BAKER CITY, ORE.—The City Council has granted the petition of the Eagle Electric Power Company for a year's extension to its franchise. Under the terms of the franchise, as it now stands, the company must have its plant in operation by October, 1912.

BEND, ORE.—The Bend Water, Light & Power Company has been granted a franchise to extend its water and electric service in new additions to the city territory.

FLORENCE, ORE.—The proposition to grant a franchise to the Florence Electric Company to install an electric-light and power system and one to the Florence-Mapleton Independent Telephone Company for a telephone system in Florence will be submitted to a vote of the people.

PORTLAND, ORE.—The Southern Pacific Company is planning to equip its railway from Portland to McMinnville for electrical operation.

PORTLAND, ORE.—Preparations are being made by engineers of the Pacific Power & Light Company for making surveys for the erection of a high-tension transmission line between Wallola and The Dalles, for the purpose of supplying electricity in the territory between the two cities. The proposed line will be about 130 miles in length and will cost about $375,000. The company owns practically all the electric plants in the Columbia, Yakima and Walla Walla River valleys.

PORTLAND, ORE.—An ordinance has been introduced in the City Council to provide more street lamps for the suburbs of the city. The contract with the Portland Railway, Light & Power Company calls for arc lamps at $75 each per year, with underground service, and $56 each per year from overhead wires. It also provides that the company extend its lighting system 1200 ft. beyond lamps in use when the contract took effect without extra charge to the city. Beyond this, however, the company refuses to install extra lamps without extra compensation from the city in addition to the rate of maintenance. Several

hundred applications for lamps have been made beyond the 1200-ft. limit. It is proposed to call for bids for lighting service in certain parts of Portland. The Mount Hood Railway & Light Company, it is understood, has offered to furnish the service.

ST. HELENS, ORE.—Application has been made by Charles R. McCormick for a franchise for an electric railway in St. Helens.

WOODBURN, ORE.—Negotiations have been closed whereby the Northwestern Long-Distance Telephone Company takes over the local telephone system, owned and operated by Henry Chappelle, of Woodburn.

WOOLLEY, ORE.—The Bellingham & Skagitt Interurban Railway Company has applied for a franchise to erect an electric-light and power plant in Woolley.

LANCASTER, PA.—Announcement has been made of the consolidation of several illuminating and power companies under the name of the Edison Electric Company, of Lancaster, Pa. The company is capitalized at $1,500,000 and was formed by the merger of the Edison Electric Illuminating Company, of Lancaster; Columbia Light, Heat & Power Company, of Columbia; Lititz Electric Heat & Power Company, of Lititz; Mountville, Penn Township, Rapho Township, Mount Joy Township, East and West Donegal Townships Electric Light Companies; East and West Lampeter Townships, Manor Township, Warwick Township and Lancaster Township Electric Companies, and Manheim Suburban Electric Company. The officers are: W. W. Greist, of Lancaster, president; George Bullock, of New York, N. Y., vice-president, and J. S. Grabill, Jr., secretary and treasurer.

LORETTO, PA.—It is reported that the management of St. Francis College has decided not to supply electricity to light the streets and residences of the borough of Loretto.

MALVERN, PA.—The Public Service Company of West Chester is erecting a new transmission line to Malvern and will soon supply electricity in this town. The company has purchased the plant and holdings of the Ridley Creek Supply Company in Malvern. The Ridley company had the contract for lighting the streets of the borough. The plant of the Ridley Creek company in Williston was not included in the purchase.

PITTSBURGH, PA.—Plans are being considered by the West Penn Railways Company for improvements and extensions to its system in western Pennsylvania, involving an expenditure of about $2,000,000. The new extensions will include one from Greenburg to New Alexandria, another from New Alexandria to Latrobe and a third to cover a district between West Newton and Scott Haven. Rights-of-way have been acquired for these extensions and surveys are being made.

PITTSBURGH, PA.—A meeting of the stockholders of the Pennsylvania Light & Power Company, of Pittsburgh, has been called for Oct. 26 to vote on the proposition to increase the capital stock from $650,000 to $1,000,000 to provide funds for extensions to its system. The company proposes to extend its transmission lines across the Ohio River into McKee's Rocks, where it obtained a franchise in September. Plans have also been completed for the installation of underground conduits over a considerable portion of the North Side, where the streets are being raised.

SHARON, PA.—The Lawrence Hydro-Electric Company, recently organized, has applied for a charter permitting it to construct a dam on Slippery Creek for the purpose of supplying power in Laurence, Mercer and Butler Counties.

SOMERSET, PA.—Preparations are being made by the Somerset Railway Company to begin work on the construction of its proposed railway between Somerset and Rockwood, a distance of 10 miles.

SUNBURY, PA.—Announcement has been made of the consolidation of the Sunbury Gas, Edison Illuminating, Sunbury Electric Light & Power, Northumberland Electric Illuminating and the United Light & Power Companies under the name of the Edison Electric Illuminating Company, of Sunbury. The company is capitalized at $250,000 and the officers are: George Scott Stewart, of Philadelphia, Pa., president; W. W. Hepburn, of Philadelphia, Pa., vice-president, and E. R. Tatnall, of Haverford, secretary and treasurer.

SIOUX FALLS, S. D.—Funds have been provided by the County Commissioners of the counties of Hughes, Sully and Stanley for preliminary investigations for developing the water-power of what is known as the Little Bend of the Missouri. It is estimated that a minimum of 35,000 hp can be developed. It is also proposed to utilize the water for irrigating purposes over a wide territory and also to use the power developed to lift the water to large reservoirs for irrigation purposes. Application will be made to Congress for permission to construct canals and dams and locks necessary.

WAVERLY, TENN.—At an election held recently the proposition to issue bonds to purchase the local electric-light plant, owned by the Waverly Electric Company, was carried.

GREENVILLE, TEX.—The building formerly used as a power house for the municipal electric-light plant was destroyed by fire on Oct. 6. A new generator valued at $2,000 was also destroyed.

SEGUIN, TEX.—Bids will be received by Rev. J. Romberg, care of C. H. Page & Brother, architects, Austin, Tex., until Nov. 2 for wiring the Lutheran College building and servants' building at Seguin, Tex.

WACO, TEX.—The City Commissioners are reported to have canceled a bond issue, voted some time ago, for the installation of a municipal electric-light plant. It is said that a contract has been awarded to the Waco Gas & Electric Company for street lighting for a period of ten years. The company, it is reported, has made a reduction of 25 per cent in the price formerly paid for arc lamps.

YOAKUM, TEX.—The Creamery Dairy Company, it is reported, is contemplating the installation of an electric-light system at its plant in addition to a 125-ton ice plant.

CHATHAM, VA.—The Town Council is reported to have decided to advertise for bids on a franchise to supply electricity in Chatham.

CLIFTON FORGE, VA.—The Clifton Forge Ice & Bottling Works are reported to have awarded contracts for additional machinery, including a 750-kw generating unit, condenser and water-tube boiler. W. G. Mathews is president of the company.

ROANOKE, VA.—Extensive improvements are contemplated by the Roanoke Street Railway & Electric Company which will involve an expenditure of about $235,000. Orders have been placed by the company for a new steam turbine for its steam power plant on Walnut Avenue, which will increase the output by 3500 hp. The new turbine and equipment will cost about $45,000; new car barns, $75,000; substation at Mason's Creek, $15,000, and new track and street paving, $100,000.

SUFFOLK, VA.—The Southern Bell Telephone Company has taken over the plant and holdings of the Atlantic Coast Company, an independent system, which operates in several cities and towns in eastern Virginia and eastern North Carolina.

CHELAN, WASH.—The Great Northern Railroad Company, it is reported, is planning to erect a large hydroelectric plant on the Chelan River gorge, near Chelan. H. M. Herzog, of Seattle, Wash., is engineer.

DUVALL, WASH.—Application has been made to the Board of County Commissioners by John F. Miller, attorney, American Bank Building, Seattle, Wash., representing local capitalists, for a franchise to operate an electric-light system and water-works system over the county roads and streets in Duval. The cost of the proposed system is estimated at about $500,000.

HANFORD, WASH.—The plant and holdings of the Hanford Irrigation & Power Company have been acquired by the Pacific Power & Light Company, of Portland, Ore. The Hanford system will be operated in conjunction with its other properties. It is said that plans are being considered for enlarging the Hanford plant at Priest Rapids. Guy W. Talbot, of Portland, Ore., is president of the Pacific company.

MORGANTOWN, W. VA.—The Union Utilities Company is planning to install motor-driven pumps at its water-works pumping station in Morgantown.

POINT PLEASANT, W. VA.—It is reported that preparations are being made for the erection of two additions to the local electric-light plant, one of which will provide space for additional electric generating machinery and the other for a cold-storage and ice plant. Samuel Sutton, it is said, has been engaged to supervise the erection of the buildings and the Bert L. Baldwin Company, of Cincinnati, Ohio, will have charge of the installation of machinery.

PRINCETON, W. VA.—The Appalachian Power Company has filed a trust deed in the office of the clerk of the county court in Princeton and in Welch on all its properties in the sum of $25,000,000. The company is capitalized at $25,000,000 and has recently purchased electric-light and power plants in addition to securing rights-of-way and franchises which permit it to erect a system of dams to furnish hydroelectric power for coal plants, villages, cities and manufacturing industries in Virginia and West Virginia.

WHEELING, W. VA.—Plans are being considered by the Wheeling Traction Company for the construction of an extension of its system from Moundsville to Barton and St. Clairsville.

LA CROSSE, WIS.—Plans are being considered by the La Crosse Water Power Company to rebuild the wrecked portions of the Hatfield and the upper dams at once, the cost of which is estimated at about $100,000. W. J. Ferris, president of the company, will have charge of the work.

MADISON, WIS.—Announcement has been made by State Forester E. M. Griffith that work has begun on the installation of a telephone system to be used as a protection against forest fires in Wisconsin.

MENESHA, WIS.—The City Council has passed an ordinance authorizing an issue of bonds to the amount of $40,000 for extensions to the electric-light plant and water-works system.

MILWAUKEE, WIS.—The Department of Public Works is reported to have awarded a contract for the installation of a steam turbine, motor generator set, etc., in the municipal incinerator to the Allis-Chalmers Company, of Milwaukee, Wis., for $12,617. Harry E. Briggs is Commissioner of Public Works.

PRESCOTT, WIS.—The Prescott dam on Kinnickinnick Creek, several miles from Prescott, which furnishes power for operating the plant of the Clifton Light & Power Company, gave way on Oct. 6, causing considerable damage to the power plant. It will cost several thousand dollars to rebuild the dam.

RANDOM LAKE, WIS.—It is reported that an electric-light plant is being installed in Random Lake.

WINNIPEG, MAN., CAN.—The City Council has rejected the propo-

sition to purchase the property of the Winnipeg Street Railway Company for $24,000,000. The municipal power plant will soon be in full operation and will compete with the company in supplying electricity for lamps and motors.

WINNIPEG, MAN., CAN.—Tenders will be received by the city of Winnipeg until Nov. 3 for furnishing incandescent carbon and tungsten-filament lamps according to specifications, copies of which may be obtained at the office of the general manager of the Light and Power Department, 449 Main Street, Winnipeg. M. Peterson is secretary of Board of Control.

SYDNEY, N. S., CAN.—The Cape Breton Electric Company is installing a 500-kw Allis-Chalmers turbo-generator set with auxiliaries at its power house in Sydney.

BRANTFORD, ONT., CAN.—Negotiations, it is reported, are under way for the consolidation of the Grand Valley Railway Company and the Brantford Street Railway Company, with a view of organizing a system of electric railways to extend from Toronto to Detroit. American capitalists, it is said, are interested in the deal.

LONDON, ONT., CAN.—Extensive improvements and extensions are contemplated by the London Street Railway Company to its system, which will involve an expenditure of about $1,000,000.

SHERBROOKE, QUE., CAN.—The Sherbrooke Railway & Power Company is building a new substation at Derby Line, Vt. It is understood that equipment has been purchased for the station.

DAWSON, Y. T., CAN.—The second unit of the Granville Power Company's hydroelectric plant on the north fork of the Klondike River, 25 miles from Dawson, has been completed. The plant now has an output of 10,000 hp.

SONORA, MEX.—C. W. Forbes, general manager of the Sonora Telephone Company, is reported to be in San Francisco, Cal., taking bids on the erection of a long-distance telephone line, to extend from Guaymas to Hermosillo. The cost of the pole line alone is estimated at $40,000.

ZIMAPAN, HILDAGO, MEX.—Application has been made by Andrew Mackenzie, of Mexico City, for a concession to erect a hydroelectric power plant on the Tula River, near Zimapan.

New Industrial Companies.

THE AMERICAN TANAGRA ELECTRICAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture apparatus for theatrical effects. The incorporators are: S. Tekulsky, 414 Central Park West; Hugh Hastings, 26 West Twenty-seventh Street, New York, N. Y., and William A. Boeckel, 467 Kosciusko Street, Brooklyn, N. Y.

THE BUSCH STORAGE BATTERY COMPANY, of New York, N. Y., has been incorporated by Charles Busch, 611 East 181st Street; Louis Heering, 25 West Sixty-fifth Street, and Oscar E. Noetling, 315 East Fifty-seventh Street, all of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture storage batteries, etc.

THE CHRON-ELECTRIC COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $25,000 by E. L., E. C. and O. M. Hueier.

THE HARBECH MOTORS COMPANY, of Chicago, Ill., has been incorporated by A. T. Ewing, E. S. Hartman and C. Bednor, of Chicago, Ill. The company is capitalized at $50,000 and proposes to manufacture motors and hardware specialties.

THE HARRISBURG STAR BOILER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $12,500 to manufacture engines, boilers, etc. The incorporators are: James S. Bowdle and James Otis, of Oswego, N. Y., and Gerald E. Otis, of Buffalo, N. Y.

THE HEATER MUFFLER COMPANY, of Elmira, N. Y., has been granted a charter to manufacture appliances for motors, engines, automobiles, etc. The company is capitalized at $50,000. The incorporators are: W. Kinzie, L. D. Curran and A. G. Ingham, of Elmira, N. Y.

THE HENRY MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture machinery, tools, engines, etc. The incorporators are: George L. Henry, 612 West 138th Street; William F. Mohr and Charles W. Caffry, 33 New Street, all of New York, N. Y.

THE HUDSON EXPORT & IMPORT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Herman May, Asher Golden and Meyer Levy, all of 91 Wall Street, New York, N. Y. The company proposes to manufacture and deal in machinery, engines, motors, etc.

THE KLING ELECTRIC COMPANY, of Peru, Ind., has been granted a charter with a capital stock of $5,000 for the purpose of dealing in electrical supplies. The incorporators are: Alpha H. Kling, Alpheus H. Kling and E. P. Kling.

THE LOS ANGELES ELECTRICAL APPLIANCE COMPANY, of Los Angeles, Cal., has been chartered with a capital stock of $5,000. The directors are: Fred F. Ives, Ross C. Holmes and Edwin D. McKinney.

THE MOTOR SPECIALTIES COMPANY, of Oswego, N. Y., has been incorporated with a capital stock of $175,000 to manufacture motors, engines, motor vehicles, boats, etc. The incorporators are: Arthur Lovell, of Plainfield, N. J.; Howard H. Williams, 31 Nassau Street, New York, N. Y., and H. V. Walsh, 551a Lafayette Avenue, Brooklyn, N. Y.

THE F. E. NEWBERRY ELECTRIC COMPANY OF ILLINOIS, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by F. E. Newberry, B. H. Bendheim and Francis Adams, Jr. The company proposes to do a general electrical contracting, construction and engineering business.

THE RICHEY TELEPHONE APPLIANCE COMPANY, of Alexandria, Va., has been incorporated with a capital stock of $6,000 to manufacture telephone appliances. The officers are: R. L. Newhouser, president; C. V. Richey, vice-president, and D. A. Bear, secretary and treasurer, all of Washington, D. C.

THE S. R. MANUFACTURING COMPANY, of Schenectady, N. Y., has been incorporated with a capital stock of $50,000 to manufacture motors, engines, motor vehicles, etc. The incorporators are: Christian Steenstrup, Karl M. Rossi and Ralph J. Ury, all of Schenectady, N. Y.

THE S. & H. MANUFACTURING COMPANY, of New York, N. Y., has been incorporated by Charles H. Stirrup, 37 Ft. Greene Place, Brooklyn, N. Y.; Frank A. Stirrup, Westfield, N. J., and Vitalis Himmer, Jr., Bayonne, N. J. The company is capitalized at $10,000 and proposes to manufacture vacuum cleaners, etc.

THE TAYLOR-HUBBARD COMPANY, of Brooklyn, N. Y., has been granted a charter with a capital stock of $100,000 to do a general engineering and contracting business. The incorporators are: Richard D. Hubbard, 164 Maple Street, and Edwin Taylor, 775 St. John's Place, both of Brooklyn, N. Y.

THE UNITED STATES STOKER CORPORATION, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000. The company proposes to manufacture mechanical stokers for furnaces, etc. The incorporators are: James L. Robinson, 309 Lafayette Avenue, Brooklyn, N. Y.; Burgess Osterhout, Freeport, N. Y., and William B. Barker, 10 Dewey Avenue, New Rochelle, N. Y.

New Incorporations.

PHOENIX, ARIZ.—Articles of incorporation have been filed for the Thousand Springs Power Company, with a capital stock of $2,000,000 by F. M. Bancroft and J. J. Crippen. The head office of the company is located in Denver, Col.

LEPANTO, ARK.—The Lepanto Light & Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: H. S. Portis, G. S. Lee and D. D. Buck.

FAIRFIELD, CAL.—Articles of incorporation have been filed by the California Terminal Company with a capital stock of $50,000 by C. W. Conlisk, W. M. Rank and R. A. Morton. The company proposes to build an electric railway from San Rafael to Sacramento, passing through the counties of Main, Sonoma, Napa, Solano, Yolo and Sacramento, a distance of 95 miles.

DOVER, DEL.—The United Water & Guarantee Company has been granted a charter with a capital stock of $1,000,000. The company proposes to construct and operate electric-light and water-works systems. The incorporators are: J. M. Deeter, of Harrisburg, Pa.; A. Grant Richwine, W. Dale Sheaser, of Mechnicsburg, Pa., and Arley B. Magee, of Dover, Del.

WILMINGTON, DEL.—The American Traction & Power Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $500,000 and the incorporators are: F. M. Shive, S. E. Roberson and Harry W. Davis, all of Wilmington.

DARIEN, GA.—The Choopee River Power & Manufacturing Company has been incorporated with a capital stock of $5,000 to generate and transmit electricity. The incorporators are: A de Sola Mendes and Wyatt de R. Barchy, of Darien, Ga.; Goodwin Thayler, Winslow H. Edwards and Charles K. Jewett, of East Hampton, Mass.; H. C. Beasley and E. C. Collins, of Reidsville, Ga.

TWIN FALLS, IDAHO.—The Twin Falls Railway Company has filed articles of incorporation with a capital stock of $500,000 for the purpose of building electric and steam railways in the vicinity of Twin Falls. The incorporators art: L. B. Perraine, of Twin Falls; Raymond McCune, E. S. Williams, D. B. Moorman, C. W. Smith and A. D. Stafford.

CHICAGO, ILL.—The Oak Hill Street Railway Company has been incorporated with capital stock of $20,000 to construct and operate street railways. The incorporators are: Charles Pullman, E. A. Isaacson, L. S. Watts and O. C. Petersen, 1201 Stock Exchange Building, Chicago, Ill.

CRESTON, IA.—The Creston, Winterset & Des Moines Railroad Company has been granted a charter to construct an electric railway from Creston to Des Moines, a distance of about 75 miles.

PRESQUE ISLE, MAINE.—The Westfield Light & Power Company has been incorporated with a capital stock of $10,000 by Lincoln R. Sinclair, Enoch B. Briggs and Thomas C. Bell, of Westfield, Maine.

CROSBY, MINN.—The Crosby Water, Light & Power Company has been organized for the purpose of constructing and operating an electric-light and power plant and furnishing water in the town of Crosby.

The company is capitalized at $50,000 and the incorporators are: William P. Harrison, Francis H. DeGroat and Grace Weiss, all of Duluth, Minn.

GLENDIVE, MONT.—The Glendive Heat, Light & Power Company has been incorporated with a capital stock of $100,000 by George H. Hollecker, N. Buttleman and others.

CAMDEN, N. J.—The International Gas & Electric Company has filed articles of incorporation with a capital stock of $1.000,000. The incorporators are: F. R. Hansell, of Philadelphia, Pa.; George H. B. Martin and S. C. Seymour, of Camden, N. J.

HUNTER, N. D.—The Hunter Light & Power Company has been incorporated to install and operate an electric-light plant by I. Moen, H. M. Weiser, Z. F. Hamilton and others.

CANEY, OKLA.—The Oklahoma Rural Telephone Company has been chartered with a capital stock of $10,000 by A. H. Utley, of Caney, Okla.; J. W. Craig, of McLester, Okla., and Z. J. DuPies, of Coalgate, Okla.

KEOTA, OKLA.—Articles of incorporation have been filed for the Keota Telephone Company with a capital stock of $5,000 by R. N. Robinson, R. A. Bonham and H. D. Price, all of Keota, Okla.

TALOGA, OKLA.—The Taloga, Putnam & Southern Railroad Company has been incorporated with a capital stock of $100,000 by Charles W. Musgrove, George W. Kouns, J. E. Rudle, of Taloga, Okla., and others.

HERMISTON, ORE.—The Hermiston Telephone & Electric Company has filed articles of incorporation with a capital stock of $7,000.

PORTLAND, ORE.—The Ewbank Power Transmission & Motor Company has been incorporated with a capital stock of $250,000 by H. B. Ewbank and G. Staples. The company proposes to develop water power and construct an electric railway system near Portland.

CLEARFIELD, PA.—The Pike Township Electric Company has been granted a charter with a capital stock of $5,000. The directors are: A. W. Bigler, of Clearfield, treasurer; W. I. Betts and W. F. Powell, both of Clearfield, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following companies: Independent Electric Company, of North Fayette Township; Independent Electric Company, of Oakdale; Independent Electric Company, of McDonald, and Independent Electric Company, of Collier Township. Each company is capitalized at $5,000, and the directors are: Robert A. Scott, of Wilkinsburg, Pa., treasurer; A. H. Mercer, N. S., Pittsburgh, Pa., and M. Wilson Stewart, of McKeesport, Pa.

TRAPPE, PA.—The Trappe Electric Company has been granted a charter with a capital stock of $5,000. The directors are: Herbert H. Ganser, of Norristown, Pa., treasurer; Daniel A. Bertolette and Montgomery Evans, all of Norristown, Pa.

CAMDEN, S. C.—Articles of incorporation have been filed for the Camden Water & Light Company with a capital stock of $70,000 by H. G. Garrison, W. M. Shannon, of Camden, S. C.; Edward C. Brainard, of Chicago, Ill., and others.

LAURENS, S. C.—The Sullivan Power Company has been granted a charter with a capital stock of $30,000. The company proposes to build a dam across the Reedy River near Tumbling Shoals and erect a hydroelectric power plant. The incorporators are N. B. Dial and J. H. Sullivan, both of Laurens, S. C.

HUNTERSVILLE, W. VA.—The Allegheny Improvement Company has been incorporated with a capital stock of $25,000 by H. M. Lockridge, J. H. Doyle, of Huntersville, W. Va.; J. A. Viquesney, of Belington, W. Va.; T. S. McNeel and C. J. Richardson, of Marlington, W. Va. The company proposes to deal in real estate and timber, build dams in Knapp's Creek, erect electric-light plants, sawmills, etc., in Pocahontas County.

TORONTO, ONT., CAN.—Articles of incorporation have been filed for the Mexican Midland Light & Power Company, Ltd., by Emil Carl Boeckh, Alexander Stewart and Henry Kilgour, of Toronto, Ont., Can.; T. Makinson Saunders and F. J. Robinson, of London, Eng. The company is capitalized at $15,000,000 and has been granted authority to build and maintain a light, heat and power plant, with privileges to construct railways, acquire timber limits and negotiate for municipal and other franchises.

Personal.

WOODMANSEE, DAVIDSON & SESSIONS (Incorporated), consulting engineers, Chicago, have opened a branch in the Wells Building, Milwaukee, Wis.

MR. FRANK G. BOLLES, formerly with the Bullock and Allis-Chalmers Companies, has been appointed secretary of the Manufacturers' Association of Racine, Wis.

MR. J. B. WHARTON, formerly of the Wilkes-Barre (Pa.) Company, has succeeded Mr. Fred. E. Shornstein as manager of the Richmond (Ind.) Light, Heat & Power Company.

MR. H. C. ALVORD, formerly in the sales department of the Montreal Light, Heat & Power Company, has been appointed sales agent of the Metropolitan Electric Company of Reading, Pa.

MR. N. G. PHELPS, formerly of the Peoria (Ill.) Gas & Electric Company, has been appointed in charge of the commercial department of the Richmond (Ind.) Light, Heat & Power Company.

PROF. A. A. MICHELSON, of the department of physics of the University of Chicago, has returned from the University of Goettingen, where he has been exchange professor during the summer semester.

PROF. WILLIAM T. RYAN, of the University of Minnesota, has returned to his educational duties, having spent the vacation period in special work in design in the Westinghouse works at East Pittsburgh.

MR. KINGSLEY GOULD MARTIN, son of Mr. T. C. Martin, was married Oct. 18 at St. Matthew's Church, New York, to Miss Katharine Moulton Thompson, daughter of Mr. and Mrs. Silas Lavater Thompson, of New York City.

GEN. IRVING HALE, manager for the General Electric Company in Denver, was stricken with apoplexy on Sept. 29 and was removed to his home in an unconscious condition. Under the care of physicians he soon rallied and has shown gratifying progress toward recovery since then.

DEAN H. M. RAYMOND, of Armour Institute of Technology, Chicago, addressed a joint meeting of the Armour Institute branch of the American Institute of Electrical Engineers and the Armour Institute branch of the American Society of Mechanical Engineers on Oct. 11. His subject was "A Few Hints to Engineering Students."

MR. C. F. KLEE has been appointed contract agent of the Merchants' Heat & Light Company, of Indianapolis, succeeding Mr. R. MacLellan, who has joined the staff of the Appalachian Power Company at Pocahontas, Va. Mr. B. D. Christian, formerly of Noblesville, Ind., has been appointed engineer of the contract department of the Merchants' company.

PROF. GEORGE D. SHEPARDSON has, after twenty years' service in the faculty of the University of Minnesota, been granted a year's leave of absence. Professor Shepardson during this period will make a study of educational methods and engineering developments and pursue a special course in the theory of the telephone at the Harvard Graduate School of Applied Science.

MR. D. A. HEGARTY, manager of the New Orleans Railway & Light Company, was appointed at the recent annual convention of the Society of Municipal Improvements held at Grand Rapids, Mich., chairman of a committee to make a report on city lighting, to be presented at the convention of that association to be held at Dallas, Tex., November, 1912.

MR. ARTHUR V. WAINWRIGHT has been appointed general manager of the Central New York Gas & Electric Company, with headquarters in Geneva, and will have charge of the properties of the company in Geneva, Seneca Falls, Waterloo, Phelps, Clyde, Newark, Palmyra and Lyons. Mr. Wainwright was previously connected with a system of electrical properties in North Carolina.

PROF. GUSTAVE GILLON, professor of electrical engineering at the University of Louvain, Belgium, is on a visit to this country in order to look up various matters relating to electric traction. This is the second visit of Professor Gillon, who spent some weeks here ten years ago, during which he visited our important central-station plants. Mr. Hector Prud'homme accompanies Professor Gillon.

LIEUT. BENJAMIN D. FOULOIS, U. S. A., who has conducted experiments for the War Department in relation to wireless signaling from aeroplanes, was recently operated on for appendicitis at an army hospital in Washington. Lieutenant Foulois is an experienced aviator, being one of the officers of the army selected to make a special study of aerial navigation. In addition, he has specialized on the possibilities of "wireless" in connection with the operation of aeroplanes.

MR. FRANK M. TAIT, formerly secretary and general manager, has been elected president of the Dayton (Ohio) Lighting Company to succeed Mr. E. P. Matthews, who remains a member of the board of directors. Mr. Tait will continue to serve as general manager, but will be succeeded by Mr. Matthews as secretary. Mr. Tait, who is not yet thirty-eight years old, has served as secretary and treasurer and is now first vice-president of the National Electric Light Association.

MR. GANO DUNN has just returned from abroad, where, as a representative of the United States government and as president of the American Institute of Electrical Engineers, he has been attending the International Electrical Congress at Turin and the meeting of the International Electrotechnical Commission, the body that has been organized to bring about international uniformity of standards and practice in the electrical industry. Mr. Dunn, who for many years was first vice-president and chief engineer of the Crocker-Wheeler Company and who is past-president of the New York Electrical Society, has been elected a director and a vice-president of J. G. White & Company, Inc.

MR. HENRY P. ERWIN, who has been made secretary of the Edison Electric Illuminating Company of Brooklyn to fill the vacancy caused by the death of Mr. Jacob H. Evans, is a lawyer and has been with the company for the past five months in the capacity of resident counsel. Mr. Erwin is a native of Tennessee, and was graduated from the academic course of Yale University in 1904, and from the Yale Law School in 1907, and was attached to the staff of District Attorney Jerome of New York City from 1907 to 1910. His election to the secretaryship of the Kings County Electric Light & Power Company will take place at the directors' meeting to be held November 1.

MR. GEORGE C. CLARKE has resigned his position as resident

engineer of the Pennsylvania Tunnel and Terminal Railroad Company to become chief engineer for the engineering contractors, Fraser, Brace & Company, New York. Mr. Clarke is a graduate of the Pennsylvania State College. During the past twelve years, while a member of the engineering staff of the Pennsylvania Railroad Company, he was actively engaged in the roadbed reconstruction work on the lines east of Pittsburgh, the construction of the passenger station at Pittsburgh and the tunnel work and electrification of the New York terminal. In his new position he will direct the hydroelectric construction work being done by Fraser, Brace & Company for the New England Power Company at Shelburne Falls, Mass.

DR. ADOLF FRANKE, director of Siemens & Halske Actien Gesellschaft, Berlin, arrived at New York on Oct. 13 and will represent the Verband Deutscher Electrotechniker at a Helmholz celebration which will take place under the auspices of the American Institute of Electrical Engineers. Dr. Franke is accompanied by Dr. A. Ebeling, chief of the Pupin department of the Siemens & Halske Company, well known for his researches in connection with the Pupin system and the design of telephone lines. Later these gentlemen will be joined by Dr. Paul Rasehorn, chief of the electrical measuring department of the Siemens & Halske Company. These gentlemen will, in company with Dr. K. G. Frank, American representative of their company, visit a number of the more important telephone installations in this country and also made a study of the effect of high-tension transmission lines on neighboring telephone and telegraph lines.

MR. SIDNEY ORIN SWENSON has been appointed electrical engineer of the Kansas City Railway Terminal Company, and will have charge of the electrical work pertaining to the new terminal, including also repair shops, coach yards, and all light and power required on the company's right-of-way. Mr. Swenson was born in Chicago August 2, 1875, and after graduating from the Chicago English High and Manual Training School in 1893, spent three years at the Armour Institute of Technology and two years at the University of Illinois, graduating from the latter institution in 1899 with his degree in electrical engineering. Immediately after graduation, Mr. Swenson went into the electrical department of the Illinois Steel Company and in February, 1900, became associated with the Commonwealth Edison Company of Chicago, his work including getting out estimates and the development of plans and wiring diagrams, following the building and construction work in the field, testing out and turning over the complete equipment to the operating department. In 1905 he left the Commonwealth Company to enter the engineering department of the New York Central & Hudson River Railroad Company, where he remained until September, 1907, engaged on engineering construction and inspection for the electrification of the New York Central Terminal, including detailed development of plans, inspecting and testing electrical equipment and superintending the installation of electrical equipment at the Yonkers power station, High Bridge terminal, etc. Mr. Swenson was assistant electrical engineer of the Detroit River Tunnel electrification from September, 1907, to July, 1911, at which time the engineering and construction work was entirely completed. Mr. Swenson is a brother of Bernard V. Swenson, formerly secretary of the American Electric Railway Association.

Trade Publications.

MAGNETIC CHUCK.—The D. & W. Fuse Company, Providence, R. I., has issued Circular No. 201, describing its magnetic chuck, which possesses a wide range of usefulness in holding pieces of iron on the grinder, shaper and milling machine.

ROLLER-BEARING CAR JOURNALS.—Bulletin No. 26, issued by the Standard Roller Bearing Company, Philadelphia, Pa., contains tests, testimonials and a description of the two general types of roller-bearing car journals developed by the company for street and high-speed interurban railway service.

SWITCHBOARD GRAPHIC METERS.—The Westinghouse Electric & Manufacturing Company has issued Circular No. 1131, describing graphic meters for switchboard service. The publication shows illustrations of the meters together with typical charts taken from same, indicating the various uses to which graphic meters may be put with advantage to the user.

SMALL MOTORS.—The Westinghouse Electric & Manufacturing Company has just issued the first number of a small monthly publication entitled *Small Motors,* which is devoted to practical applications of small motors, including views of motors in actual service, such as operating ice cream freezers, small lathes, washing machines, grinding wheels and numerous other household devices. One application shown is an auxiliary to the furnace, to increase the draft, to increase the distribution of heated air by drawing it from the pipes and forcing it into the room, to ventilate a steam-heated room, and in other ways to assist in the heating and ventilation of the home. Advice as to installation, operation and care of the motors is given in short practical talks. *Small Motors* is distributed to central stations and dealers the first of every month.

RECENT LAMP CATALOGS.—"The Fortress of Lamp Quality" is the title of an illustrated booklet recently issued by the Shelby Electric Company, Shelby, Ohio, which describes in an attractive and instructive fashion the development and engineering facilities enjoyed by the manufacturers of Shelby lamps. The Shelby company has also issued a catalog covering types, prices and discounts on Shelby incandescent lamps of all classes in large, street-series and miniature styles. A vest-pocket compendium of commercial information on Peerless lamps has been prepared by the Warren Electric & Specialty Company giving ratings, voltage ranges, prices and discounts, with a small cut of each type listed. The Sterling Electrical Manufacturing Company, of Warren, Ohio, in its new loose-leaf catalog lists and describes not only the more common types of incandescent lamps, but also the spiral carbon-filament type and the Sterling single-unit fixtures and "Mazdafore" clusters for industrial lighting. The page is punched for binding, and additional sheets will be issued whenever changes in lamp data make it advisable.

ELECTRIC PLEASURE VEHICLES.—The Waverley 1912 Catalog embodies a new idea in catalog making. The earliest product of the Waverley factory was named after the Waverley novels, and the scheme of decoration for this year relates to incidents and characters from the novels themselves and scenes associated with Abbotsford, the home of Sir Walter Scott, as the setting of the narrative. The outside cover displays in green and gold figures in medieval armor taken from the entrance hall at Abbotsford. The inner cover shows Scott's coat of arms under a three-color picture of the Waverley 1912 limousine in the garden at Abbotsford. Across the tops of all the inside pages runs a frieze in three colors and gold representing the tournament in "Ivanhoe." A portrait of Sir Walter backs up the title page, and in the wide margin on either side of the printed matter appear panel portraits of different Waverley characters. The two central pages of the catalog are devoted to a large four-color halftone of a Waverley car on the Abbotsford estate. The artist employed to illustrate the catalog was Frederick Richardson, the well-known book illustrator of Chicago. Besides the purely decorative pictures the catalog is well furnished with half-tone illustrations of Waverley cars, showing both interior and exterior views, those on pages 5, 7 and 9 being especially noteworthy, while the descriptive matter accompanying the pictures is unusually full and convincing.

BUSINESS NOTES.

AMERICAN DISTRICT STEAM COMPANY has moved its general offices from Lockport, N. Y., to its new works at North Tonawanda, N. Y.

THE HASKINS GLASS COMPANY has moved its Chicago office to the Marine Building, 136 West Lake Street, and placed in charge Mr. A. H. Krom, formerly of the Commonwealth Edison Company, of Chicago, who will act as branch manager.

PUTTING TELEGRAPH WIRES UNDERGROUND IN KANSAS CITY.—The Western Union Telegraph Company is making an extension of its underground construction in Kansas City. The contract for doing the work has been awarded to the Graner-Mahoney Contracting Company, of St. Louis.

CHICAGO ARC LIGHTING.—For controlling the arc circuits of the new Chicago street-lighting system, the Delta-Star Electric Company, of Chicago, has been awarded the contract for a new type of automatic oil circuit-breaker having a rating capacity of 15 amp at a voltage of 12,000. The contract for these switches was awarded by the Sanitary District.

STEEL TRANSMISSION STRUCTURES.—The Archbold-Brady Company, Syracuse, N. Y., has issued an attractive bulletin on its products for transmission lines, including transmission line supports and anchor structures, special river and railroad crossing structures, catenary bridges and cross catenary supporting poles. Brief descriptions of typical installations form part of the bulletin. The illustrations represent successful solutions of a variety of problems which involve fabricated steel structures of a different character from those ordinarily used in building, railroad or bridge work.

AN EXCELLENT ADVERTISING CARD.—The Bryant Electric Company, of Bridgeport, Conn., has issued a unique advertising card, which at the same time has a direct practical value. It is devoted to the Bryant interchangeable line of "New Wrinkle" sockets, switches and other wiring devices, and consists of a heavy base card 14 in. x 12 in., to which is attached a revolvable disk 10 in. in diameter. The various bases and caps which make up the line are printed on the base card and the shells on the disk. This permits each of the twenty shells to be brought against any one of the twenty-six caps and bases, and when this is done the catalogue or style number of every one of the 520 complete articles formed by the union of the two parts shows through a slot in the disk. On the reverse side of the heavy card is an index of catalogue numbers which includes standard package quantities and list prices. It will thus be seen that this card covers what it would require many pages of a catalogue to list properly and at the same time renders it possible to obtain in its entirety an illustration of every completed device, for examination to determine if it possesses the requisite features. As nothing identical seems ever to have been made before, a patent for the device has been applied for by Mr. Frank V. Burton, the Eastern sales manager of the company, who originated the device and produced it, and who also directs all of the company's publicity work.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 10, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,005,121. CIRCUIT INTERRUPTER; C. Aalborg, Wilkinsburg, Pa. App. filed Oct. 7, 1908. An oil-containing casing for the contacts has an enlarged surface area.

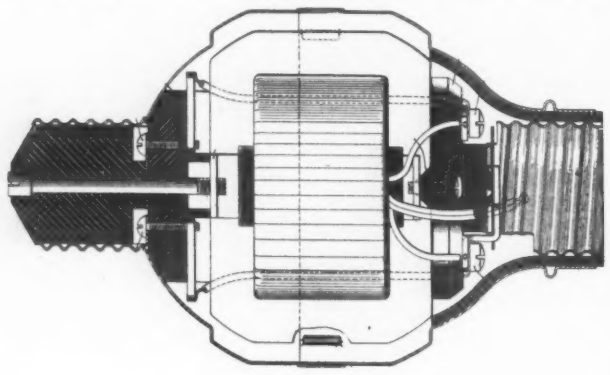
1,005,129. ELECTRIC LAMP AND SERIES CIRCUIT CUT-OUT; F. W. Andrew, Wilkinsburg, Pa. App. filed Sept. 20, 1906. Two sets of contacts widely separated for insulation.

1,005,134. FLEXIBLE CONDUIT; H. H. Balliett, Pittsburgh, Pa. App. filed Oct. 10, 1910. Inner and outer tubes and two intermediate helical coils.

1,005,163. TRANSFORMERS; F. Conrad, Swissvale, Pa. App. filed Jan. 10, 1908. In the form of a socket for tungsten lamps.

1,005,166. ELECTRICALLY HEATED TRAY; F. L. Crombie, Detroit, Mich. App. filed May 8, 1911. Asbestos sheet and heat unit to set in a serving tray.

1,005,179. GUARD FOR TELEPHONE AND TELEGRAPH WIRES;



1,005,163.—Transformer.

C. J. Elliott, Oxnard, Cal. App. filed July 11, 1910. A guard surrounds each wire and is connected to an adjacent wire of different potential.

1,005,192. BINDING POST; G. Garretson, San Diego, Cal. App. filed Jan. 17, 1911. A bolt with a notched head and a clamp nut.

1,005,194. TELEPHONE SYSTEM; T. W. Gleeson, Boston, and W. H. Gilman, Medford, Mass. App. filed Aug. 5, 1907. A "farmer's" party line to prevent interference and to insure release.

1,005,199. BATTERY CONNECTOR; J. H. Gugler, Milwaukee, Wis. App. filed Jan. 22, 1909. The carbon has a cavity filled with oil surrounding the binding post.

1,005,221. MOTOR CONTROL; J. D. Ihlder, New York. App. filed Oct. 11, 1905. Artificial power-consuming device to equalize load as in elevator work with alternating-current induction motors.

1,005,222. ELECTRODYNAMIC BRAKE CONTROL; J. D. Ihlder, New York. App. filed March 13, 1908. For automatic or push-button elevator systems with floor controllers.

1,005,237. ALTERNATING-CURRENT ELECTROMAGNETIC SWITCH; D. Larson, Yonkers, N. Y. App. filed Nov. 26, 1907. Mounted on a vertical baseboard; has a weighted armature.

1,005,252. VEHICLE-BRAKING SYSTEM; J. N. Mahoney, Wilkinsburg, Pa. App. filed March 25, 1907. Automatic fluid pressure system for trains to stop detached cars first and then stop the front cars so as to avoid collision.

1,005,253. REFILLABLE CARTRIDGE FUSE; E. B. Mallory, Wilkinsburg, Pa. App. filed June 17, 1911. Has disks for holding the knife-blade terminals in position.

1,005,283. SPRING BINDING POST; L. M. Neher, Milford, Ind. App. filed Feb. 11, 1908. A sheet-metal spring loop with overlapping perforated tongues for the wire.

1,005,293. REGULATION OF THE VOLTAGE OF ALTERNATING-CURRENT MACHINES; C. A. Parsons and Alexander H. Law, New Castle-Upon-Tyne, England. App. filed Sept. 16, 1910. A synchronously rotating inductor varies the reluctance of a magnetic circuit for automatically compounding loads of different power-factors.

1,005,307. OUTDOOR TRANSFORMER; K. C. Randall, Edgewood Park, Pa. App. filed Oct. 18, 1909. Double walls with ventilating passages to shield the tank from the sun.

1,005,316. CONTACT FINGER; E. E. Rose, Swissvale, Pa. App. filed Feb. 2, 1907. For drum-type controllers; means for adjusting the pressure and movement of the finger.

1,005,323. SPRING-FASTENING DEVICE; J. Schade, Jr., New York. App. filed June 22, 1908. A wire-receiving socket and a spring-engaging arm.

1,005,338. TRANSMITTING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed June 17, 1905. A rotating commutator for wireless signaling; a battery of condensers discharged through a circuit without a spark-gap.

1,005,350. CONTROLLER; H. A. Steen, Pittsburgh, Pa. App. filed July 8, 1909. Two control drums, a single operating handle and interconnections for governing either or both of two motors.

1,005,355. VARIABLE-SPEED MOTOR-CONTROLLING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed March 13, 1908. The acceleration of a motor is controlled by current from a generator running with the motor.

1,005,357. COOKING APPLIANCE; A. L. Sykes, Covington, Ky. App. filed May 16, 1910. An electric heater in the bottom of a shallow receptacle and with a deep cover.

1,005,360. ELECTRIC-HEATING DEVICE AND METHOD OF CONSTRUCTING THE SAME; H. R. Taylor, Wilkinsburg, Pa. App. filed Dec. 31, 1908. An insulated resistance element is held under pressure between two curved metal plates.

1,005,393. TELEPHONE SYSTEM; C. S. Winston and E. H. Rupe, Chicago, Ill. App. filed Dec. 19, 1904. Cord circuits are adapted for use with various types of lines, such as magneto common-battery signaling and common-battery talking lines.

1,005,395. FUEL HEATERS; M. J. Wohl and A. A. Low, New York; App. filed Oct. 17, 1907. A bent pipe between resistors for heating liquid fuel prior to carbureting for engines.

1,005,402. ELECTRIC SWITCH; A. A. Zeigler, Boston, Mass. App. filed Feb. 16, 1910. Integral connections between a binding post and a switch contact for railroad signaling, etc.

1,005,418. SIGNAL CONTACT; E. R. Cunningham, Des Moines, Ia. App. filed Sept. 3, 1910. For trolley roads. The contacts are carried by a housing over the trolley wire.

1,005,420. APPARATUS FOR CONTROLLING MOTORS; F. W. Darlington, Philadelphia, Pa. App. filed Dec. 14, 1909. Pneumatically controlled switches for a single car or number of cars.

1,005,445. ELECTRIC-CAR CONTROLLER; H. T. Maib and E. O. Rowe, Spokane, Wash. App. filed Dec. 22, 1910. A safety device to prevent the circuit-breaker from blowing out when the motors are reversed and the car is still going ahead

1,005,471. ANTENNA; R. H. Rendahl, Liljeholmen, near Stockholm, Sweden. App. filed June 7, 1910. Thin metal tubes of large diameter held in a row.

1,005,475. THERMAL ELECTRICAL PROTECTOR; C. A. Rolfe, Adrian, Mich. App. filed April 21, 1902. A number of solder-secured elements and a rotatable arm for resetting.

1,005,482. ELECTRIC SIGN AND METHOD FOR MAKING THE SAME; H. A. Schmidt, Chicago, Ill. App. filed Jan. 31, 1910. A Crooke's tube is partly embedded in cement.

1,005,483. DEVICE FOR CUTTING SLEET FROM TROLLEY WIRES; E. Slingluff, Cincinnati, Ohio. App. filed April 29, 1910. A rotatable cutter is mounted above the usual trolley wheel.

1,005,506. TERMINAL CONNECTION OR COUPLING FOR ELECTRIC CONDUITS; W. S. Brown, New York, N. Y. App. filed May 16, 1910. A cast socket and sheet-metal clamp strap.

1,005,517. FUSE; A. F. Daum, Pittsburgh, Pa. App. filed Nov. 23, 1910. A fuse strip under tension and with an indicator. Improvement on Patent No. 961,716.

1,005,521. CUT-OUT; H. W. Doughty and C. E. Beach, Binghamton, N. Y. App. filed Oct. 16, 1900. An insulating block with contact slides between two insulating blocks with terminals.

1,005,575. AUTOMATIC CIRCUIT-BREAKER; E. C. Raney, Crooksville, and C. E. Simmons, Steubenville, Ohio. App. filed Oct. 10, 1908. Self-opening and closing, for motor circuits.

1,005,612. ELECTRICAL VIBRATING DEVICE; H. N. Cupp, Mars, Pa. App. filed Sept. 7, 1910. Double solenoid for riveting hammers, etc.

1,005,628. METHOD OF MAKING COMPOUND METAL ARTICLES; H. W. Fisher, Pittsburgh, Pa. App. filed June 16, 1909. One metal at or above its melting point is electrodeposited upon another and an additional coating of the first then cast upon the deposited coating.

1,005,635. ALL-PORCELAIN ELECTRICAL LAMP SOCKET; E. H. Freeman, Trenton, N. J. App. filed April 1, 1910. Two-part base with snap switch inclosed.

1,005,638. MOTOR-CONTROL SYSTEM; H. E. Frost, Cleveland, Ohio. App. filed Oct. 1, 1910. A master switch controls electromagnetically operated switches which control the motor.

1,005,649. APPARATUS FOR EXPLODING MINE CHARGES; J. Krannichfeldt, Cologne, Germany. App. filed Feb. 19, 1907. A master-hand switch controls individually the local exploding switches.

1,005,671. ELECTROLYTIC DEVICE; W. B. Thorpe, Balham, London, Eng. App. filed Jan. 12, 1909. For recording meters, etc.; gas-tight joint; insulation.

1,005,672. ELECTROLYTIC APPARATUS; W. B. Thorpe, Balham, London, Eng. App. filed Aug. 18, 1909. Re-combining gas type of meter, etc.; ignition device.

1,005,700. CONTROL SYSTEM FOR ELECTRIC MOTORS; F. R. Fishback, New York, N. Y. App. filed Feb. 28, 1910. Some of the speed-controlling switches effect more than one motor speed.

1,005,714. CABLE DUPLEX SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed Dec. 22, 1908. For telegraphy; two transformers of different ratios of transformation.

1,005,715. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Dec. 19, 1908. Long-distance duplex telegraphy; a single key for controlling a plurality of sources.

1,005,718. ARRANGEMENT OF ELECTRODES FOR THE ELECTROLYTIC REFINING OF METALS; F. M. Kohler, St. Petersburg, Russia. App. filed Dec. 28, 1909. Anode plates and a frame form a container for the electrolyte and the cathode.

1,005,725. ELECTRIC FURNACE; G. Massip, Paris, France. App. filed Sept. 23, 1910. The hearth is internally heated by the current so as to become a conductor and form one electrode.

1,005,754. ELECTRICAL WATER HEATER; M. H. Shoenberg, San Francisco, Cal. App. filed April 29, 1911. The water supply cannot be cut off while current is on.

1,005,758. PROCESS AND APPARATUS FOR TESTING ELECTRIC METERS; E. M. Wilkins, Mexico City, Mexico. App. filed Aug. 12, 1907. For comparing rotary registering meters, one of which has a mark upon a rotating part.

1,005,786. SPRING-FASTENING DEVICE; J. Schade, Jr., New York, N. Y. App. filed June 22, 1908. Sheet-metal strip formed with a wire receiving socket in its stationary end and another socket in its spring-arm end.